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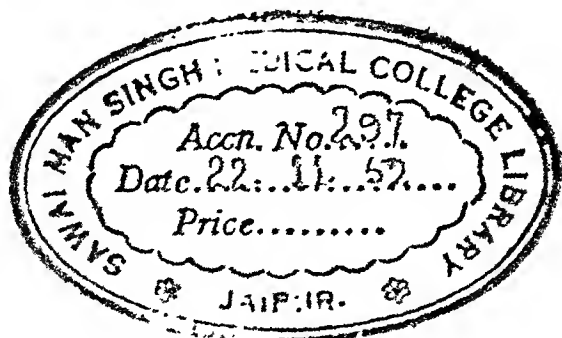
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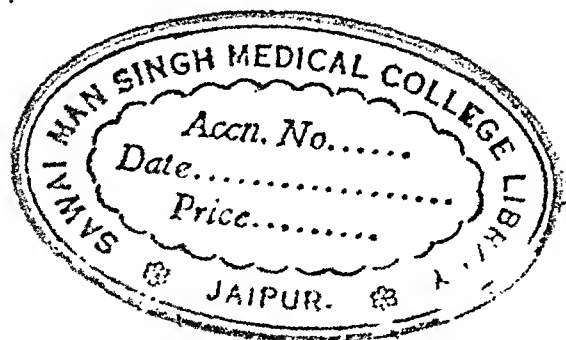
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THE STORY OF THE RED CROSS INSTITUTE FOR THE BLIND  
(1918-1925) IN RELATION TO THE PRESENT PROBLEM  
OF THE WAR BLINDED\*

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The Red Cross Institute for the Blind, organized first as General Hospital No. 7, but generally known as the Evergreen School for the Blind, was the agency established during the World War I for the training and rehabilitation of members of the armed forces who became blind. The problem of the training and rehabilitation of similar cases occurring in the armed forces is now becoming a pressing one. It is pertinent, therefore, that former experiences in this field be reviewed as the new program for the training of the blind is formulated. Various phases of the history of the Evergreen School have already been reported.<sup>1-7</sup> From these various publications, a diary kept by Dr. James Bordley, and from personal experience, the following epitome of the history of this institution is drawn.

Shortly after the outbreak of hostilities in 1917, the National Defense Council appointed a Subcommittee of Ophthalmology. Subsequently, many members of the Committee became attached to the Surgeon General's Office in one capacity or another. While still a member of this Committee, Dr. James Bordley of Baltimore became interested in reconstruction plans of other warring nations, especially as concerned the blind. His conclusion was that a program for the rehabilitation

of the blind would best be undertaken by such an outside agency as the American Red Cross. A tentative plan to this end was submitted to the American Red Cross with the result that Mr. Henry Davison, the Director General of the American Red Cross, laid the subject before the Surgeon General with an offer from the American Red Cross to finance the project. This offer was declined on the ground "that the Secretary of War was not inclined to accept financial aid from civilian agencies." The program for the training and rehabilitation of the blind then became a charge of the Surgeon General's Office.

In the summer of 1917, the late Mrs. T. Harrison Garrett, on the suggestion of Dr. Bordley, offered her estate in the suburbs of Baltimore as a site for the establishment of a school for the re-education of blind soldiers. This was inspected by "a sub-committee of blind educators," and a report recommending the acceptance of this offer was duly made to the Surgeon General. It was endorsed by him and later by the Secretary of War, and this lot of ground, 99 acres with several buildings, was taken over on November 17, 1917, by the Government at a rental of one dollar per annum. Plans for the remodeling of the existing buildings and construction of new buildings were then drawn. There was, however, some delay in the appro-

\* From the Wilmer Ophthalmological Institute of the Johns Hopkins University and Hospital.

priation of the necessary funds, and it was not until April, 1919, that the actual new reconstruction was begun. The first patients were received in April, 1919, and housed in the buildings then available. By the fall of 1919, construction was substantially completed, equipment was installed, and the instruction was begun, the school being known as General Hospital No. 7, under the Surgeon General's Office. At no time in its existence, however, should the Evergreen School be considered as a hospital. Blind soldiers, returning from overseas, and still in need of medical attention, were referred to a general hospital at Cape May, New Jersey, where special equipment and personnel had been provided for the care of eye patients. There the blind soldiers were kept until it was felt that further hospital care was no longer needed, at which time they were transferred to General Hospital No. 7. From this source, other hospitals, and later other vocational training schools, the students at Evergreen School were derived. Such medical care as was needed by these blind students was provided at first by the Army Medical Corps.

The Evergreen School remained as General Hospital No. 7, under the Medical Department of the United States Army, until May 25, 1919. At that time it was believed that blinded patients would be benefited by a termination of their military status. There were also certain obvious advantages in having the institution under the control of a private agency, a more elastic expenditure of funds being feasible. Accordingly, early in 1919, the Surgeon General recommended to the War Department that blind soldiers requiring no further treatment be discharged from the Army, that those requiring further treatment be transferred to General Hospital No. 2 at Fort McHenry, Maryland, and when

such treatment was completed, they also be discharged. All such discharged blind soldiers were to be turned over to the Federal Board of Vocational Education and the War Risk Insurance Bureau. Military supervision should extend only to the maintenance of order and discipline and the preservation of property. These recommendations having been approved, and the offer of the American Red Cross having been renewed, on May 25, 1919, all buildings and equipment were turned over to the American Red Cross on a revocable lease, so that organization, in coöperation with the Federal Board of Vocational Training, could carry on the instruction of the blind. The institution now became known as the Red Cross Institute for the Blind. Dr. James Bordley, then Lieutenant Colonel, was appointed Director, being allowed by the Surgeon General to combine this duty with his assignment in the rehabilitation section of the Surgeon General's Office. Such medical attention as was required by the students was provided by various consulting ophthalmologists, and by special consultants employed by the Public Health Service.

Under the Red Cross, the Evergreen School reached its fullest development and maximum usefulness. A fund of approximately four and a half million dollars was raised by public subscription for the development and maintenance of the Institute. The full capacity of the Institute was 150. Prior to December, 1918, the maximum number of patients was below 50. Thereafter it increased, and, after being taken over by the Red Cross, the number of students remained between 100 and 150.

There was no fixed period of instruction. The usual course of instruction consisted of a preparatory course, consisting of Braille, English, typewriting, and handwriting. Thereafter the student en-



tered one or another of the vocational courses until it was determined for which one he was best individually equipped. In the selected field he received instruction until it was felt he was prepared for civilian life, either at home, in the blind shops, in industry, or agriculture, or was prepared to enter some university or professional school for special training. The vocational courses consisted of agriculture, including poultry raising and dairy farming; commerce, including store-keeping; industry, including auto-shop repairing; vulcanizing; cigar manufacturing; novelty work; weaving; woodworking; and tire repairing. "Avocational" courses in life insurance, bookbinding, basket making, and weaving were given. Abundant recreational facilities were available—music, dances, public speaking, and the like—in addition to bowling alleys and a swimming pool.

Especially interesting was a model store established at the school, where all details of purchasing, salesmanship, and store management were taught to the blind soldiers. A second store known as the "Evergreen Victory Stores" was established at Perryville, Maryland, and later a number of similar chain stores were established by the blind men themselves in various localities, all controlled and financed by the Red Cross Institute for the Blind. In general it was the policy of the school to afford the students the widest possible latitude, so that the blind student might obtain the kind of training he desired, provided it was advisable and practical. The professional and teaching staffs were in the main recruited from the staffs of various blind schools throughout the country, with special volunteer instructors in special fields from time to time. A reception home was established in Baltimore for the families and relatives of the blind students. When a student was transferred to Evergreen, an

effort was made by the Red Cross to have his parent or close relative come to Baltimore to meet him, see him installed in the Institute, and be with him during the first days of readjustment. All expenses, including traveling expenses, were borne by the Red Cross.

The Evergreen School continued under the administration of the Red Cross from May 25, 1919, to January 1, 1922. On August 9, 1921, the Veterans' Bureau was established. Up to this time the medical and hospital service for discharged veterans had been administered by the Public Health Service, and the rehabilitation program by the Federal Board for Vocational Education. The duties of these organizations had grown to the point where the divisions handling veterans' relief had expanded until they greatly overshadowed their parent organizations. The Veterans' Bureau was organized to relieve the Public Health Service and the Federal Board of these duties, and to combine them under one organization. In line with this program, there was no place for the Red Cross in the picture, and accordingly, on January 1, 1922, the Red Cross Institute for the Blind was turned over "in toto" to the Veterans' Bureau, under whose charge it remained, with gradually waning and diminishing usefulness and activity until its final demise and closure in June of 1925.

My personal association with the Evergreen School began early in March of 1920, at which time I was appointed consulting ophthalmologist, a post which I continued to hold, under various auspices, until the final closing of the school in 1925. During this period I personally examined every student already in the school or thereafter admitted. My experience therefore covers the last two years of the Red Cross administration, and the final three years under the Veterans' Bureau. During this period, in addition to

the regular service and Veterans' Bureau records, I kept a personal file of all histories and examinations.

In this personal file are 325 case records, which represent the total number of men trained at Evergreen from March 23, 1920, when I held my first clinic, up to the final close of the school in June of 1925. The actual number of men who received blind training at Evergreen during its entire life (as General Hospital No. 7, the Red Cross Institute for the Blind, and under the Veterans' Bureau) would be these 325 men plus men discharged prior to March of 1920. I have been unable to obtain an accurate record of the number of men who finished training and were discharged prior to March of 1920. However, there is a report of the individual soldiers admitted to Evergreen up to May 25, 1919, when it functioned as General Hospital No. 7. One hundred and seventeen soldiers were admitted to Evergreen up to that date. A comparison of my file against this record reveals 60 of these 117 soldiers were still at Evergreen in March of 1920, 57 having been discharged. The number of men admitted after May 25, 1919, who completed their education and were discharged prior to March of 1920, must have been very small. It seems therefore a conservative estimate that 75 would represent the total number of discharges prior to March of 1920, and that the total number of soldiers and students that passed through Evergreen during its entire life under its various auspices was in the neighborhood of 400.

A review of the 325 case histories shows that, on the basis of ocular pathology, they may be divided into the following groups, with the indicated number of men in each group: cases of trauma, 106; of optic-nerve disease, 66; of hysterical amblyopia, 27; of atrophic choroiditis, 17; of retinitis pigmentosa, 14; of amblyopia due to systemic disease, 12; of

errors of refraction, 14; of war-gas injuries, 12; of cataracts, 12; of uveitis with secondary cataracts, 8; of superficial keratitis, 9; of interstitial keratitis, 8; of trachoma, 5; of amblyopia due to cortical injury, 4; of detachment of the retina, 4; of glaucoma, 3; of superficial retinitis, 2; of keratoconus and nystagmus, 1 each.

*I. Cases of trauma.* There were 106 soldiers in this group. Seventy-eight of these men had suffered war wounds and were therefore blinded as a result of enemy action. In the remaining 28 the ocular trauma had not been inflicted by enemy action, but was the result of various accidents which occurred chiefly in training camps in this country and abroad.

As has already been stated, an indeterminate number of soldiers, probably in the neighborhood of 75, had been discharged from Evergreen before my association with the school began, and there are no records available on some of these men. In the majority of cases the disability was due to trauma, mainly to battle injuries, for these were the first students sent to Evergreen. It seems, therefore, a fair assumption that the total number of soldiers blinded by enemy action who were later trained at Evergreen was in the neighborhood of 150.

The general types of wounds in this group were what might be expected following injuries from high explosives, shrapnel, gunshot, machine guns, bombs, and hand grenades. There were 16 cases of bilateral anophthalmos and 25 cases of unilateral anophthalmos, the second eye being blind from phthisis bulbi, traumatic cataract, detached retina, proliferating changes, and so forth. There were four cases of bilateral phthisis bulbi. There were 10 cases in which there had not been penetrating wounds of the eyes, but in which the soldiers, as a result of explosion or remote injuries, had suf-

ferred bilateral concussion changes in the fundus, with the final picture of choroidal scars and atrophic choroiditis. There were four cases of cortical blindness, following occipital-lobe injuries. The remaining cases of blindness due to enemy action were an assortment of penetrating wounds, detached retinas, traumatic cataracts, and proliferating changes.

The 28 cases in which the ocular trauma did not result from enemy action were due usually to injuries sustained in training camps—the accidental explosion of percussion caps or hand grenades, blows on the eye or head, falls, and such accidents as might occur in civilian life. The six cases of blindness due to burns were the result of acid burns, most of which were sustained in civilian occupations after discharge from the Service.

*II. Optic-nerve disease:* The 66 cases of optic-nerve disease were distributed as follows: primary syphilitic atrophy, 22; primary atrophy of the nerve, cause undetermined, 17; secondary, post-neuritic atrophy, cause undetermined, 4; papillo-macular-bundle atrophy, suspected or proved multiple sclerosis, 13; toxic amblyopia (wood-alcohol poisoning), 6; atrophy secondary to sinus disease, 2; atrophy secondary to brain tumor, 2. There was nothing remarkable in this group. The large number (17 cases) of primary atrophy of undetermined cause is probably a reflection of inadequate study of the patients, while the six patients blinded by wood alcohol is a sad reminder that the Evergreen School flourished in the late unlamented prohibition era.

*III. Hysterical amblyopia.* The hysterical amblyopia group, 27 in number, was of considerable interest. Twelve of these patients confessed to vision of 2/60 or better, while 12 others had either no light perception or at best could detect hand

movements. The three remaining individuals were believed to be straight malingerers. The entire group presented much the same sorry spectacle—nervous, psychoneurotic individuals with every imaginable complaint. Their diagnosis and condition were known to the other students who, almost without exception, regarded them as “fakes.” They were more or less objects of general scorn. Poor students, they remained in the school year after year, shifting from one department to another, and the majority of them became hopelessly institutionalized. When the school was finally closed, they were distributed to various psychopathic hospitals, where they would probably have been better off from the beginning. They presented much the same ophthalmologic picture, with tremor of the closed lids, and often only partial voluntary control of the extraocular movements. Blepharospasm was common. Those who still retained some vision uniformly had visual fields contracted usually to about the 10-degree meridian. None showed any ocular pathology on objective examination.

There was a small but very interesting subgroup of cases of unilateral hysterical amblyopia, which are not included in the main group. There were six men in this category, all of whom showed the common picture of having lost one eye, usually either from wounds or disease, with the second eye objectively entirely normal. As the time approached for their discharge from the hospital where they had been treated for the ocular injury or disease, they began to develop failing vision in the second eye without any demonstrable pathologic basis. In three patients the final vision in the otherwise normal eye was from 20/100 to 20/200, in two it was in the neighborhood of 20/40. All six of these individuals had the usual pictures of tremor of the lids, constricted fields, and so forth. In one

individual, whose one eye had been lost from a mustard-gas injury, the vision in the second eye declined to the ability to see hand movements. Three of these six men had lost the first eye from wounds or explosives, two from mustard gas, and the last from an extensive choroiditis. They are especially interesting in that their hysteria manifested itself in their own original disability-blindness.

*IV. Atrophic choroiditis.* The 17 men in this group were not unusual. Sixteen had extensive bilateral atrophic choroiditis, while in one the disease was still active. Several of these men were carefully studied, while others refused any further medical attention. Two were known syphilitics, three had extensive foci of infection, two were obviously tubercular. In the remaining cases medical surveys were either negative, inadequate, or were totally lacking. In all 17 vision was so reduced, or the visual fields so damaged, that they were indubitably blind.

*V. Retinitis pigmentosa.* The 14 members of this group showed nothing noteworthy except their comparative youth, the average age of these patients being 28 years. In every individual the symptoms of the disease first became apparent while he was in the service. This brings up the interesting point of whether the physical stress of military service may be a predisposing factor in the early outbreak of this disease in individuals who have an hereditary tendency. Three of these patients still had central vision of 20/40 or better, but their constricted fields, annular scotomata, night blindness, and hopeless prognosis made them proper candidates for a blind school.

endophthalmitis following cerebrospinal meningitis, three cases of bilateral endophthalmitis following influenza-pneumonia, three cases of postneuritic optic atrophy following meningitis, two similar cases following influenza, and one case of embolus of one central retinal artery, the second eye being normal. This patient's condition was similar to that of several men who were sent to Evergreen under the Veterans' Bureau Administration.

*VII. Errors of refraction.* There were 14 men whose only ocular pathology was a high refractive error, although in 3 cases the myopia was complicated by choroidal changes. Five of these individuals had a minimum of 20/30 corrected vision in each eye. One had 20/40 and 20/100 corrected, three had high myopia with myopic choroiditis and vision of 20/200 or less in the better eye, while four had high hyperopia, with 10° diopters of hyperopic astigmatism, and vision of 20/200 or less. One man was believed to be a straight malingerer. Some of these individuals were admitted to Evergreen under the Red Cross Administration, having been sent by the Federal Bureau, and two were admitted under the Veterans' Administration. They appeared, with various other companions, to represent a lot of ne'er-do-wells who had tried one type of vocational training after another in various centers, had been chronic failures at everything they attempted, who consistently blamed their failure on their eyes, and who finally had been shipped to a blind school in sheer desperation to get rid of them. In the main, these men were a group of chronic trouble-makers.

*VIII. War-gas injuries.* The 12 gas injuries could be divided as follows: 8 cases of recurrent keratoconjunctivitis following mustard gas, incurred as a result of

enemy action; 4 cases of uveal-tract disease following liquid-mustard burns, 2 eyes having been enucleated. The symptomatology in these cases has been commented upon elsewhere.<sup>8</sup> As already noted, two of these patients with unilateral eye injuries only developed a hysterical amblyopia in the second eye.

*IX. Cataracts.* The 12 patients with cataracts represented an interesting group. The average age of this group was 30.6 years. Five patients had straight posterior cortical cataracts without any other evidence of ocular pathology, with vision of 20/100 in the better eye. Operation had been advised, and apparently refused, the patients preferring to remain partially blind and to draw pensions. One patient had congenital posterior polar cataracts with 20/40 vision in each eye, while three patients had been operated upon with poor results, two on one eye only and one on both eyes. The two patients who had had unilateral operations preferred to keep the small amount of vision remaining in the second eye rather than risk another operation. Another patient with bilateral cataracts had had one successful operation, with 20/20 corrected vision resulting. Even though he had only light perception in the eye that had not been operated on, he refused to wear his correcting lens before the operated eye that had undergone surgery. Since there was no way of compelling the discharged soldier to do so, he was sent to a blind school! The last patient was unusual in that he had dotlike opacities in the anterior cortex, the picture of metabolic cataracts for which no cause has been found. He had 20/20—vision in one eye and 20/30 in the second.

*X. Uveitis.* There were eight cases of old uveitis with blindness resulting from the usual complications—secondary cataract, secondary glaucoma, occlusio pupil-

lae, and so forth. None of these had been sufficiently studied to make even a reasonable guess as to the etiology of the ocular disease. All of these patients were blind, the maximum vision being, for example, as in one man who had 20/200 vision in one eye and no light perception in the second eye. There was nothing especially noteworthy in the entire group.

*XI. Keratitis.* There were nine patients in whom the blindness was due to superficial scarring of the cornea from an old ulcerative keratitis. All except one of the patients had vision below 20/200 in the better eye. One patient had 20/100 in one eye and 20/60 in the second, but the social and mental status of this patient was such that the visual defect constituted a major handicap and his blind education was quite justifiable.

There were eight patients with syphilitic interstitial keratitis. One of them was unusual in that it was undoubtedly a complication of acquired syphilis, the first onset of the keratitis coming on 10 months after the initial lesion. One of those whose syphilis was congenital deserves special mention. He was 35 years of age, a quaint character, who had all the possible stigmata of congenital syphilis, had had repeated attacks of keratitis since childhood, had no light perception in one eye, and only 20/200 in the second eye. His chief delight in life was telling any audience he could corner the story of his life-long battle against "them lues." Just how he was ever admitted to the Army, and so became a life-long pensioner of the Government, has always been a mystery. The other six men who had congenital syphilis were all industrially blind, and were not noteworthy.

*XII. Trachoma.* In all the five cases of trachoma there was marked corneal involvement and each of the men was industrially blind. Two were old cases

of patients who had had the disease prior to their entrance into the Army. Three had apparently acquired the disease in the service. There was nothing remarkable in any of the patients.

*XIII. Detachment of the retina.* There were four cases of detachment of the retina. One of these was bilateral, of undetermined cause. Three were unilateral—in one case the second eye was amblyopic, in the second case the other eye was the site of an extensive choroiditis, while in the third case the second eye was entirely normal, with a full 20/20 vision. By what misguided agency this last patient was sent to a blind school, there is no record.

*XIV. Glaucoma.* There were only three patients with uncomplicated glaucoma in the Evergreen School. One of these was totally blind from an advanced glaucoma not brought to operation; the second had had bilateral iridectomies performed without effect, and at the time of examination had 20/50 vision in one eye and only light perception in the other. The last patient had a typical glaucoma, for which there had been no operation, with 20/50 vision in one eye and 20/70 in the other. The glaucoma was uncontrolled by miotics, and the patient, refusing operation, was duly sent to a blind school, which was perhaps as good a place as any for him.

*XV. Retinitis.* There were two patients under this diagnosis. One was blind from bilateral holes in the macula, while the second had a superficial retinitis which developed after exposure of the eyes to extreme infra-red rays. This patient had 20/50 vision in one eye, and could detect hand movements only in the other eye.

*XVI. Keratoconus.* The one patient with keratoconus was a woman, the only

female among the students. There is no record available of her vocation or why she was admitted to Evergreen. The vision was approximately 20/200 in each eye.

*XVII. Nystagmus.* There was only one student on whom this was the primary diagnosis. The right eye of this man was amblyopic, and had been badly damaged by an earlier operation designed to correct a strabismus. The second, presumably normal, eye developed a nystagmus of undetermined etiology, which reduced the vision to 20/50. In this state the patient was admitted to Evergreen.

#### COMMENT

A survey of the history of the Evergreen School and the men admitted there as students brings up certain pertinent questions as concerns the men blinded in the present war. *First.* How many blind men may be expected from the Armed Forces during the present war? *Second.* Should an agency somewhat similar to the Evergreen School be established as a training school and rehabilitation center for such blind men? *Third.* What should be the criteria for admission to such a rehabilitation center, and who should be the judges of these criteria? *Fourth.* Are men blind from hysterical amblyopia proper individuals for training in a blind school in association with the mentally stable blinded? *Fifth.* Under what agency and direction should such a school be established?

In the light of our experiences at Evergreen these questions may be briefly commented upon.

*First.* The total population at Evergreen during its entire existence was probably about 400. There were, however, a number of men blinded in the last war, either by enemy action, accident, or dis-

ease, who were not educated at Evergreen. I have found no accurate figures of this total. In one report of the Veterans' Bureau,<sup>9</sup> it is stated that 260 blind men had been or were being educated at Evergreen and 130 blind men in other institutions. With the exception of a center in District No. 9, where apparently the chief subject taught was poultry farming, with side lines of basketry and rug weaving, it is not stated where or what these other institutions were, or whether the blind men sent there had been former students at Evergreen. It is quite probable that blind men educated in other institutions might in many instances have been former inmates of Evergreen, who following various vicissitudes after discharge, had wound up in other Veterans' Bureau facilities. In this same report (page 429), mention is made of the colored blind, but no figures are given. It is probable that the total number of service men who received special training after the last war on account of visual defects was in the general neighborhood of 500, of whom about one half were war casualties. This was for a total of approximately 4,000,000 men over a period of approximately two years. If we estimate the duration of this war as three years plus, and the total of the Armed Forces at roughly a maximum of 10,000,000 men under similar conditions, we might expect a total of roughly 2,000 men who will require education for the blind. However, conditions are not entirely similar. Large numbers of men have not been continuously engaged in trench warfare, there has as yet been no gas warfare, and the better organization of the medical department and the use of sulfa drugs may appreciably lessen the incidence of blindness from wounds. The differences between modern mechanized warfare and trench warfare may well tend to lessen the incidence of blind-

ness from wounds. Further, there are as yet few casualty figures available from this war on which any adequate estimate of incidence of blindness can be based. Any estimate of the number of blind casualties is therefore little more than a guess.

As concerns blindness resulting from disease, the conditions are more comparable. It is possible that the employment of routine Wassermann tests before induction may lessen the incidence of blindness due to syphilis and late optic-nerve atrophy. The use of sulfa drugs may materially lessen the incidence of blindness from meningitis, and other infections. Except for these instances the conditions existing in 1918, as concerns blindness due to disease, do not appear materially different from those of today, and it seems a fair estimate that some 500 men blind from local or systemic disease must be expected in the present enlarged armed forces. Summing this up, it seems probable that if the war continues, and land fighting becomes widespread, there will, in all likelihood, be at least 1,000 blind whose special training and rehabilitation will become pressing problems. The figure may be much higher.

*Second.* If this number of blind, or any number approaching it must be given special training, it is obvious that an institution, somewhat similar to Evergreen, must be established in the immediate future. The civilian blind schools in this country are totally unable to cope with a problem of this magnitude, and there is no provision in the present Veterans' Bureau or any other Federal or public agency for such special training for such a group. The attempt to farm such blind men out to civilian institutions or various Veterans' Bureau facilities would result in an unevenness of training and care to the extent that it would become a national



scandal. This is especially true since there is no class of casualty so calculated to appeal to public sympathy as is that of the war blinded. It would seem that the answer to the question of whether a special institution to train the War Blind should be established, must be an unequivocal "Yes."

*Third.* The first point in relation to the student personnel is under what conditions men should be admitted to such a blind-training school. The present admirable program of the Office of the Surgeon General of the Army provides that all men who become blind in the various theatres of operation should be sent to Valley Forge General Hospital in the East and to the Letterman General Hospital in the West. There the psychiatric readjustment and blind training will begin as soon as the soldier is admitted to these centers, and will continue until his discharge. He will be discharged from these hospitals only when he has reached his maximum therapeutic and physical rehabilitation. Serious cases of ocular accident and disease are to be sent to certain designated hospitals, especially equipped for eye work, where the patient will remain until he no longer needs special hospital care. On release from these eye centers, the blind soldiers will be discharged from the Army and ready to enter a blind school.

This program contains at least one essential criterion for the admittance of students to a blind school; namely, that they shall have reached their maximum therapeutic and physical rehabilitation before entering upon vocational studies. The school should be a school, and not a hospital. Of necessity an ophthalmologist must be in constant attendance to care for the endless minor and the occasional unexpected major ocular complications which will develop in a blind population.

A small eye clinic, and hospital facilities for the occasional serious unexpected complication must therefore be available, but this should be incidental, and no student should be admitted who still requires active hospital care.

The second criterion relates to the visual status of the students. Obviously, all soldiers (with the possible exception of those hysterically amblyopic) who come under the definition of blindness adopted by the Subcommittee of Ophthalmology of the National Research Council should be eligible for blind education. This definition of blindness is that the maximum of vision in the better eye be not greater than 20/200, or, if greater, that the visual field be not greater than 20 degrees in its maximum diameter. There is, however, the problem of the visually handicapped whose vision is greater than that specified in this definition. In May of 1921, the Federal Board placed at Evergreen "men with more than 1/10 vision if the degree of defectiveness prevented them from successfully pursuing the courses in which they had previously been placed elsewhere. After a tryout the Director approved the plan as a 'sight-saving' class."<sup>10</sup> A review of the 325 case records available from the Evergreen School shows that 43 students were not blind under the aforementioned definition of blindness, and were potential members of this "sight-saving class." Certain of these individuals were undoubtedly proper candidates for a blind education. Such were eight men who had completely lost one eye through battle wounds, with injuries to the second eye reducing the vision to 20/100. Two were men with extensive choroiditis, with 20/50 maximum vision in one eye. Very many had irregular fields and scotomata, and several had cases of pigmentary degeneration, young men whose vision was still greater than specified in the definition of



blindness but in whom the rapid progress of the disease indicated a hopeless prognosis. As to the remaining cases in this group, there was certainly no obvious reason, even under the "sight-saving" excuse for the blind education of these men. While some latitude should be allowed for men not blind under the rigid definition given above, the proper machinery should be provided to exclude men who, although visually handicapped, still have usable vision. After the last war there was certainly an undoubted tendency on the part of other rehabilitation centers to get rid of their poor material, patients who blamed their failures on visual handicaps, by shipping them off to a blind school. There they showed no ardent desire to absorb a blind education, were constant trouble-makers, and seriously interfered with the morale and discipline of the school, and in the main reflected discredit on the institution. It seems a reasonable suggestion that if any institution for the training and rehabilitation of the war blinded be again established the authorities of such an institution should have the absolute power to accept or reject men sent there for vocational training. Men who qualify under the rigid definition of blindness as hereinbefore quoted should be admitted without question. All others recommended for admission should be passed on by a committee made up from the institution's administrative personnel, consisting of an ophthalmologist, a worker trained in educating the blind, and an administrative officer. This committee should have the power not only to admit but also to dismiss unsuitable students from the school and refer them back to the Veterans' Bureau for other disposition.

*Fourth.* The soldiers with bilateral hysterical amblyopia present an especial problem. Certainly our experience with

this group at the Evergreen School was unfortunate. Once admitted to the School, and rated as blind, they received a pension, and thereupon their blindness became firmly fastened to them for life. By and large, they were miserable students, scorned by their fellows who had lost their vision by disease. As a group they became hopelessly institutionalized, and at the close of the School in 1925, many were still there, to be disposed of to psychopathic or other Veterans' Bureau institutions. Like the men with too much vision, they tended to be trouble-makers and to interfere with the work of the institution.

The disposition of those with bilateral hysterical amblyopia presents a special problem for the psychiatrist. Certainly the solution does not appear to be to pension them as blind, and to undertake their education and rehabilitation on this basis.

*Fifth.* Under what agency should this proposed blind school be established? The history of the Evergreen School is interesting on this point, in that it was at various times under the direction of three different agencies—the War Department, the Red Cross, and the Veterans' Bureau. Conceived and built under the direction of the Surgeon General's Office, it soon became evident that far greater flexibility was needed for its successful operation than was possible under the existing tables of organization, and there can be little question that the decision to turn the School over to the Red Cross was a wise one. While the direction of a blind school by the War Department with students still on a military status solved the difficult problem of discipline, in all fairness it must be admitted that the education and rehabilitation of the blind is scarcely the function of a Department whose fundamental duty is to wage war.

Under the administration of the Red

Cross the Evergreen School expanded and flourished. A review of the "Manual of the Red Cross Institute for the Blind" gives the impression that the School was well organized and was run with a fair degree of economy. From my personal observation I should unhesitatingly say it was efficiently run. The morale of the students was high, the instruction appeared to be good, the men were interested in their work, and the graduates were well trained and proficient in their trades. Many of these men I have followed since their discharge and, all in all, they have been reasonably successful in civilian life. Had the Red Cross continued in charge of the School, it might well have developed into a second St. Dunstan's—a permanent national institution for the training of the blind, and a home for those who are so handicapped that they can work only in shops for the blind. Had this been the outcome of the Evergreen School, we might now be prepared for our present problem.

From January 1, 1922, to the close of the School in June, 1925, the School was under the direction of the Veterans' Bureau, and this was the period of decline. While various indictments may be made against the Veterans' Bureau management, and some may be well substantiated, it is very doubtful if, under the existing circumstances, the outcome could have been much different. In the first place, the Veterans' Bureau was a newly created organization, charged with a tremendous task, and it was probably inevitable that there should be some unevenness in its early organization. Second, as far as the students were concerned "the cream was off the milk." The 117 men admitted when the School was known as General Hospital No. 7 were battle casualties who were the aristocrats and elite of the student body. The men admitted under the Red Cross adminis-

trations were partly battle casualties, and partly men who had lost their sight through accident or disease. As the School went on, the percentage of battle casualties decreased, the number of syphilitics and psychoneurotics became greater. With the removal of military status and the decline in the caliber of the student body, discipline became a vexatious problem. The men were all objects of sympathy, and, except for their blindness, were generally in excellent physical condition. They had all the natural appetites and desires of healthy men of their age. Their blindness largely cut them off from general public life and the usual social contacts, and likewise prevented their finding an outlet in other pursuits—athletics, movies, and the like. Prohibition did not help the situation, for the bootlegger and his usual attendants showed no reluctance to cheer the hours of idleness that hung heavy on the blind man. Disorders of one type or another were not infrequent. While it is quite true the trouble-makers were in the minority, nevertheless in the closing years of the institution they kept things more or less agitated and seriously interfered with the general morale of the institution. Third, the Veterans' Bureau was not charged with the perpetuation of the Institute for the training of the blind nor of permanent shops for the blind. The National Rehabilitation Program was terminated by law in 1926. Several years before the actual winding-up of the School, it was known that it was only a question of time before the institution would be closed. Competent instructors sought and found other positions. The replacements were not especially interested in their make-shift and temporary appointments. With the decline in the quality of the students and caliber of the teaching staff, the morale sank to a low ebb and discipline became lax and almost nonexistent. It must be admitted that the

closing months of the Evergreen School were neither spectacular nor stimulating. Yet, I doubt if the fault was due as much to the Veterans' Bureau administration as it was to factors beyond their control, especially to the fundamental policy of terminating the vocational rehabilitation program for the blind.

Since it will probably soon become imperative that an institution similar to Evergreen be again established, how can the conditions that characterized its somewhat dreary ending be avoided? The training of the blind disabled veteran is by law a direct responsibility of the Veterans' Bureau and falls to the Division of Vocational Rehabilitation. It is to this agency that one must look first for a solution of the problem. There are at present in the Vocational Rehabilitation Division some limited facilities for the training of the blind, but it would appear these are inadequate for a task of the magnitude of the present one. Many of the men blinded in this present war will, like other blind men, be incapable of self-support or sustenance in civilian life, and will be of the class who can work only in supervised shops for the blind where they may work out their lives at maximum usefulness to themselves and society. Others, after completion of their vocational training, will adjust themselves to civilian life. It would seem, therefore, that the wisest step would be to establish a national institution for the blind veterans, which would combine a vocational training school and a permanent home and workshop for such of the blind as may require institutional protection. If the Division of Vocational Rehabilitation of the Veterans' Bureau decides to adopt some such plan and is permitted by law to carry it out, the problem will probably be solved and an institution may result which will be comparable to St. Dunstan's in England, with its splen-

did record of achievement. Were such an institution established it might well be expanded to train and care for the blind who are the charge of other Federal agencies. This at the moment seems to be the logical solution of the problem and it is to be hoped that some such constructive policy will be adopted. The alternatives appear to be amplification of the existing facilities of the Division of Vocational Rehabilitation, the enlisting of the services of some private agency, or the creation of a new subdepartment to handle the question.

An amplification of existing facilities in a veterans' hospital does not appear to be a wise solution. In a recent report, Davenport,<sup>11</sup> the medical officer of St. Dunstan's, has well emphasized that the essential point in the rehabilitation of the blind veteran is that he be first in a community in which all are much on the same basis, where the physical set-up—guide rails, bumpers in the corners of the walls, and so forth—is especially adapted to his peculiar problem, and where he is free from the tendency of others to do too much, or occasionally too little, for him. In a general hospital, the blind man is more or less in contact with patients who are not visually disabled. Undue attention on the one hand, or the careless leaving of chairs in unaccustomed places, or doors ajar on the other hand, are apt either to increase his dependence or to shatter his growing confidence through a bad crash. If the blind man is surrounded entirely by companions who face the same general problem he does, he becomes one of a community, the restoration of his self-confidence is aided, and his physical and vocational rehabilitation is hastened.

The second alternative—enlisting the support of an outside agency such as the Red Cross—has certain points in its favor and also some obvious objections to

it. The record of the Red Cross administration of the Evergreen School was admirable, and St. Dunstan's in England has reached its present enviable position as a privately supported institution. Yet the question may well be asked why a private organization, supported by public subscription, should undertake a task that is obviously the responsibility of a government agency. Should such a national institution for the blind be established under private or semipublic auspices, the Division of Vocational Rehabilitation might theoretically enlist its facilities on a contract basis. This, however, might well lead to an obvious division of authority and responsibility, and the continuity of financial support would not be assured. These might not be unsurmountable difficulties, but, barring some compelling reason for such farming-out of Veterans' Bureau responsibilities, they would ap-

pear to be valid objections.

The creation of a new government agency or subdepartment of an existing agency to handle the problem seems to be an unnecessary complication, since the machinery to handle the solution already exists. Suggestions have already been made for the establishment of a National Institute for the Blind, as an independent organization under either government or semipublic auspices. The need for such an independent or semi-independent institution has not yet been demonstrated. That there is an immediate problem for solution cannot be doubted, but, with the existing machinery in the Division of Vocational Rehabilitation of the Veterans' Bureau, it is to be hoped that a satisfactory answer can be found and the mistakes of the last war in the handling of the problem of the blind can be avoided.

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## CORNEAL-VASCULARIZATION PROBLEMS\*

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About 150 years ago, Soler<sup>1</sup> noted that in pellagra the eyes might appear rheumy, and that the cornea might be involved in an inflammatory process the severity of which bore a relation to the state of the general disease.

In 1939 Bessey and Wolbach<sup>2</sup> observed that "vascularization" of the cornea is an early and constant phenomenon in albino rats that are riboflavin deficient. This manifestation precedes all other demonstrable lesions due to the deficiency. Johnson<sup>3, 4</sup> made similar observations at about the same time. In 1940 Sydenstricker, Sebrell, Cleckley, and Kruse<sup>5</sup> reported on two large series of malnourished patients with cheilosis and corneal changes who were studied intensively by the slitlamp technique. Johnson and Eckardt<sup>3</sup> made a similar study on the corneal disorders in acne rosacea. The entire problem has been reviewed extensively by Wagoner<sup>6</sup> and requires no discussion at present.

This report is concerned with an extensive study of the corneas of 711 patients seen in the Nutrition Clinic in Birmingham, Alabama, during 1940 and 1941, and in the Out-patient Department of the Ophthalmic Department, College of Medicine, University of Cincinnati, in 1942.<sup>†</sup>

In the conjunctivoscleral wedge covering the peripheral rim of the cornea a more or less extensive meshwork of vessels is normally present. It is derived from dichotomically dividing and repeatedly anastomosing conjunctival vessels, and has connections with episcleral and

even intrascleral vessels more peripherally. According to Duke-Elder,<sup>7</sup> whom we are quoting here almost word for word, this wedge occupies an area corresponding—in cross-section—to a triangle, the apex of which lies at the termination of Bowman's membrane, whereas its base abuts against the episcleral tissue and the superficial part of the sclera. Here the anterior ciliary arteries form a rich anastomosis, ending in a series of arcades that give off final branches. These marginal loops bend around on their own tracks to form venules leading into a venous plexus built up on similar lines. The anterior ciliary arteries, coursing along the tendons of the recti muscles, send off anterior conjunctival vessels just before they pierce the globe. These anastomose with the posterior conjunctival offshoots to form the pericorneal plexus.

From this pericorneal plexus vascular arcades are given off which enter the transilluminable part of the limbus, so that their final loops seem to be situated in transparent tissue that is merely the conjunctivoscleral wedge and not corneal tissue. The pericorneal plexus lies around the region of the limbus on two planes; namely, the superficial and the deep limbal loops. Imbedded in the conjunctivoscleral wedge, the superficial limbal loops may extend into this transparent zone for 2 mm. in the upper and lower limbal sectors (Leber<sup>8</sup>), while nasally and temporally they do not penetrate so far. The deep limbal loops do not form a continuous network; they enter the corneal tissue

\* From the Department of Ophthalmology, College of Medicine, University of Cincinnati. Read at the seventy-eighth annual meeting of the American Ophthalmological Society, in Hot Springs, Virginia, June, 1942.

† The patients observed in Birmingham were referred for the eye examination by the director of the Nutrition Clinic, Dr. T. Spies and (or) by his assistants, Dr. W. Bean and Dr. R. Vilter.

more widely separated from each other, forming simple loops or more complicated patterns with anastomosing branches. They are situated between Bowman's and Descemet's membranes, sometimes very close to the latter. Some of them accompany the corneal nerves for a short distance. In biomicroscopy, they

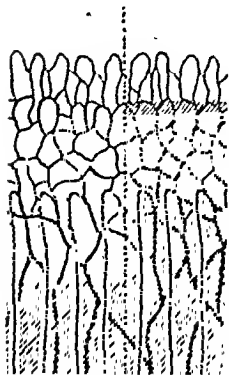


Fig. 1 (Vail and Ascher). Schematic drawing showing the limbal loops in direct and retroillumination; in the latter, many arcades seem to be situated in the transparent area (from Vogt,<sup>9</sup> a modified redrawing).

are not so often visible as are the vessels of the superficial limbal plexus. Indirect illumination occasionally reveals more of them, due to the partial translucency of the scleral tissue bordering the limbus proper (figs. 1 and 2).

#### PHYSIOLOGY OF THE LIMBAL LOOPS

The superficial marginal plexus often shows a granular blood stream with varying limpid gaps between longer or shorter groups of red blood corpuscles. Frequently, however, the loops are entirely free of blood cells. This seems to be the usual state of the most distally situated loops. Absence of red corpuscles was believed to be an indication of emptiness of these loops. It is improbable, however, that they are entirely empty at any time, since they are imbedded in a relatively firm tissue. On the slightest stimulus they rapidly fill with red blood corpuscles, as in inflammation or engorgement. Irritation from a small foreign body caught between the lid and bulbus, or even rubbing of the lids, suffices to fill with red

cells, at least temporarily, smaller or larger groups of previously invisible loops (Vogt<sup>9</sup>).

We shall not, at this time, discuss the nature of the fluid that fills the apparently empty loops; it may be blood plasma, which is supposed to fill capillaries free of corpuscles in other parts of the body (Bordley<sup>10</sup>), but it is possible that in this region the blood plasma is diluted at a varying ratio by aqueous humor leaving the canal of Schlemm by numerous small outlets the majority of which are regularly invisible (Ascher<sup>11</sup>).

#### LIMBAL HYPEREMIA

Any hyperemia in the limbal meshwork should be judged—(1) for its intensity, and (2) for its extent. The intensity of hyperemia can be estimated biomicroscopically by the density, or calculated by the number, of individual vessels visible in a single microscopic field. On the other hand, the extent of limbal-mesh-

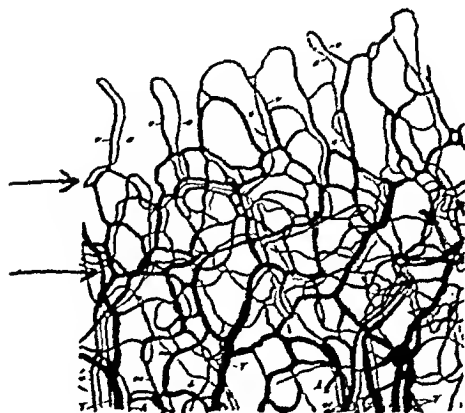


Fig. 2 (Vail and Ascher). Showing an injected specimen of the limbal meshwork. The vessel sections which, by engorgement, may form concentric collaterals are clearly visible. *A*, episcleral branches of anterior ciliary arteries; *V*, episcleral branches of anterior ciliary veins; *a*, arterial limb of marginal loops; *v*, corresponding venous limb; *ac*, *ve*, anterior conjunctival arteries and veins (from Leber<sup>8</sup>). Arrows indicate possible concentric collaterals.

work hyperemia is to be judged by the number of arcades actually filled by blood corpuscles (figs. 3 and 4).

Differentiation between intensity and extent of limbal-meshwork hyperemia has not been attempted in ophthalmology up to this time, but such differentiation is justified by observation of many hundreds of limbi and may help in the classification of puzzling conditions observed in this region. The intensity of the hyperemia of the limbal meshwork parallels the severity of the causative pathologic process. The extent of the hyperemia of the limbal meshwork is dependent on the duration of the disease. As a more intensive conjunctival process develops, and as the bulbar conjunctiva becomes involved, a larger number of limbal loops becomes filled with red blood corpuscles. When an acute process recedes, only the proximal arcades remain filled

with red blood cells while the more distal ones become free of red corpuscles unless there has been an inflammation of longer duration.\* Involvement of the corneal

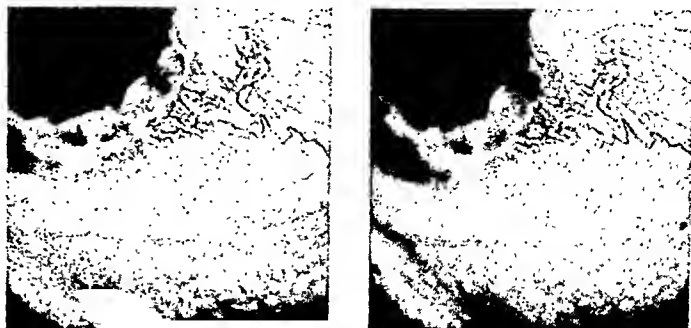


Fig. 5 (Vail and Ascher). Stereophoto of the right eye of Aldie C., a white woman, aged 32 years, first seen on May 4, 1941, with right nasal pterygium and the right semilunar fold drawn toward it, out of the nasal angle. Congestion of the bulbar conjunctivas was present in the exposure region of both eyes. On June 6th, a marginal ulcer in the right nasal lower corneal quadrant, not far from the head of the pterygium, was observed. Vessels approached but never reached the ulcer. Diagnosis: riboflavin deficiency. Note the extensive filling of the limbal loops, combined with low intensity of congestion.†

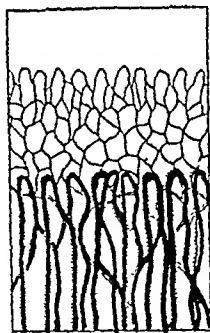


Fig. 3

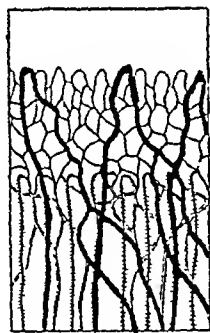


Fig. 4

Fig. 3 (Vail and Ascher). Showing intensive hyperemia in the limbal loops. In this case the extent is very low; the distal meshwork is practically empty, but the proximal vessels are maximally filled.

Fig. 4 (Vail and Ascher). Showing limbal hyperemia of medium intensity and high degree of extent; not all proximal limbs are filled, but blood is visible in some of the most distal arcades.

Fig. 6 (Vail and Ascher). Showing real corneal vascularization. This occurs only if and where corneal pathology is present. Only in these cases do newly formed vessels enter the corneal tissue proper, and in only such cases do vessels trespass on the preformed limbal meshwork.



tissue induces not only filling of even the most distal arcades, but genuine vascular proliferation into the corneal tissue proper (fig. 6 and stereophoto 5).

#### PATHOLOGY OF THE LIMBAL LOOPS

So long as no real vascular proliferation takes place the expression "corneal

\*In distinguishing the arcades we prefer the expressions "proximal," that is, closer to the equator bulbi, and "distal," that is, closer to the corneal center, instead of "peripheral" and "central."

† Stereophotos were taken by Mr. Bennett, of Chicago, in June, 1941.



vascularization" should be avoided, regardless of the fact that filled vessels are present and visible in a transparent tissue.

Sydenstricker and his co-workers deserve credit for having directed our attention to a certain form of congestion in this region described as corneal vascularization due to vitamin deficiency.

In 1940 Sydenstricker<sup>5</sup> stated that the cornea is actually invaded by very small capillaries arising from the apices of loops surrounding the scleral digitations. In 1941<sup>12</sup> he described, as the first and possibly only sign of riboflavin deficiency, the following observations, made by means of a corneal microscope with the slitlamp: "The normal avascular zone between the plexus and the sclerocorneal junction is overrun by minute vessels from which spring capillary loops which outline the scleral digitations." Later he stated: "We have not observed an instance in which an arcade of capillaries framing the scleral projections has not been proved to be abnormal." The development of these vessels has been followed closely under experimental conditions. "Within a few days, often only two, empty capillaries can be seen arising from the apices of the loops outlining the scleral projections. These capillary sprouts lie immediately beneath the corneal epithelium and extend centripetally. In two or three days more they form complete loops through which red cells circulate irregularly and in clumps. The efferent limbs of such loops are often difficult to see. Such vessels grow rapidly and anastomose with adjacent capillaries to form a secondary arcade of loops lying within the cornea. From this, more sprouts develop and grow centripetally with many anastomoses until an extensive superficial plexus is formed which may cover the peripheral two thirds of the cornea. Later, and usually after several recurrences of ariboflavinosis, vessels may invade the sub-

stantia propria at all levels . . . usually only after prolonged deficiency, diffuse nebulae develop at various levels in the substantia propria."

Amos<sup>12</sup> found a higher percentage of ocular changes in a "sea-going" group of the Canadian Naval Service than in the "barracks" group. Difference in diets in both groups is mentioned, but there is no mention as to whether this "sea-going" group really was exposed to the ill effects of the sea climate or only to dietary insufficiency.

MacDonald<sup>14</sup> stated that he had observed a greater incidence of "severe ariboflavinosis according to the present diagnostic technique with the slit-lamp" in men of the Royal Navy who had been at sea for longer periods. Among 100 men who had been subsisting on a carefully checked diet, there were a few cases of mild corneal vascularization.

#### PERSONAL OBSERVATIONS

Comparing our observations on patients in the Nutrition Clinic in Birmingham, Alabama, with the conditions described by Sydenstricker, we found a large number of cases of conjunctivitis, some without and many with involvement of the bulbar conjunctiva. Where the bulbar conjunctiva was involved, varying degrees of engorgement of the limbal meshwork were observed. Entrance of newly formed capillaries into corneal tissue proper was never encountered except in cases with antecedent corneal disease. In the limbal meshwork, however, there was a peculiar formation which attracted our attention and raised the question of its possible association with vitamin deficiency.

While normally any limbal loop possesses both an afferent and an efferent limb (fig. 2), in numerous patients many afferent and very few—sometimes only



one—efferent vessels were found in each quadrant of the limbal circle. This is contrary to the normal condition described by Krueckmann,<sup>15</sup> who believes that most of the pericorneal plexus is venous in character (fig. 7).

We became convinced that, except in corneal diseases, the condition described as corneal vascularization is merely an engorgement of the preëxisting limbal plexus. In some instances these vessels finally form shorter or longer continuous efferent branches along, and paralleling, the limbus. For these vascular features, which up to this time have not been sat-

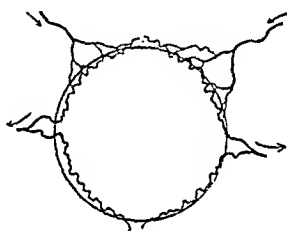


Fig. 7 (Vail and Ascher). Fully developed concentric collateral. All venous blood is collected in the single anastomosing vessel running toward the horizontal meridian.

isfactorily described and even less satisfactorily explained, the term "concentric collaterals" is proposed.

#### DEFINITION

Concentric collaterals are engorged parts of the preëxisting limbal meshwork. They are charged with the collection of blood from all limbal loops of one entire limbal quadrant, or a part of them, and with the return of this blood from the limbus to the larger conjunctival veins (figs. 7, 8, 15, and stereophoto 10\*).

\* Some weeks after the presentation of this paper, a description of limbal vascularity by Graves (Brit. Jour. Ophth., 1934, v. 18, pp. 305, 370) was incidentally found that pertains to structures similar if not identical with the concentric collaterals. A picture showing these vessels is reproduced with the legend Normal Limbus (fig. 1, p. 312).

#### NOMENCLATURE

In Stedman's Medical Dictionary (1939) as well as in the Oxford English Dictionary (1939) and in Funk and Wagnall's Dictionary (1928) vascularization is defined as the formation of new

Fig. 8 (Vail and Ascher). Showing an incomplete concentric collateral. The blood returns by individual venous limbs in the region between the 12- and 1:30-o'clock position. From here down to the 3-o'clock position all blood is collected by an anastomosing vein which runs parallel to the limbus.



blood vessels, or as the conversion to a vascular condition. It is obvious that the limbal concentric collaterals do not correspond to this definition. The usual term for pathways formed by dilatation of pre-existent narrower vessels which thus allow a new although preformed direction of circulation is "collateral."

#### APPEARANCE

A fully developed concentric collateral starts near the 12-o'clock position in the upper or/and near the 6-o'clock position in the lower limbus and proceeds, in a

Fig. 9 (Vail and Ascher). Showing a progressive concentric collateral. Arcades situated distally from the primary anastomosing arc are being filled.



somewhat tortuous route, toward the nasal or temporal horizontal meridian here to join conjunctival veins running toward the semilunar fold or toward the temporal canthal region (fig. 7 and stereophoto 10).

Rudimentary concentric collaterals do not comprise the whole quarter of the limbal circle, and in these cases the finally efferent vein does not become so large

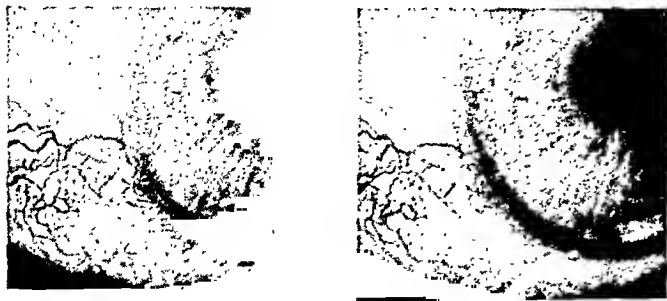


Fig. 10 (Vail and Ascher). Stereophoto of the left lower nasal concentric collateral of Myrtle B., a white woman, aged 42 years.\* The collateral covers almost the whole quadrant. The diagnosis of the Nutrition Clinic was riboflavin deficiency. The patient gave a history of "red eyes" since childhood, of burning, watering, photophobia, and hemeralopia for many years. Her diet was very high in food containing vitamin B. She had been taking vitamin-B preparations for many months. Her mother died of tuberculosis. The patient had not had any serious disease since 1925, at which time an appendectomy was performed. X-ray examination of her chest gave evidence of "old lesions." There was papillary hypertrophy in her tarsal conjunctivas, slight injection of the latter as well as of the fornices and semilunar folds. Pingueculas were present in the nasal conjunctiva of both bulbi, and hyaline and calcareous deposits in both bulbar conjunctivas. In July she developed cheilosis of both angles.

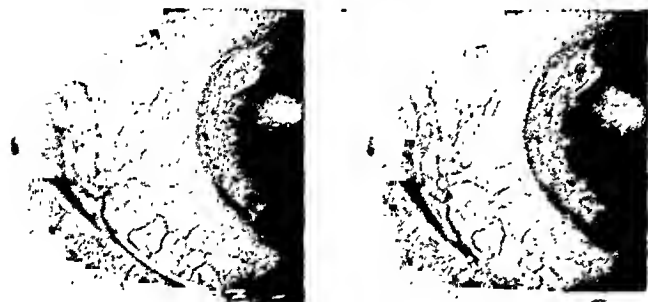


Fig. 11 (Vail and Ascher). Stereophoto of the incomplete concentric collateral in the right eye of Joe H., a white man, aged 35 years. The diagnosis of the Nutrition Clinic was nicotinic-acid deficiency. He showed a slight injection of all parts of the conjunctivas, particularly in the exposed bulbar conjunctival areas. Numerous hyaline and a few lipoid deposits were present in his bulbar conjunctivas. Four pingueculas were present. The limbal loops were partially filled. In the right temporal upper quadrant, between the 10- and 11-o'clock positions, the venous return from all limbal loops was provided by a concentric anastomosis finally joining a large vein in the horizontal meridian. In the picture the right temporal pinguecula is almost invisible.

\* The connection between the concentric collateral and the vein in the horizontal meridian, in this picture, is not so clearly visible as when viewed with the corneal microscope.

and conspicuous as in the cases in which involvement of a whole quadrant is present (fig. 8 and stereophoto 11).

Being formed out of arcs of the limbal meshwork, the concentric collaterals look like a series of elements that are convex toward the corneal center. Sometimes, however, they may be concave for the whole or a part of the concentric collaterals, due to apparent extensions in the central direction (figs. 9 and 16). Exact observation shows that these extensions are more distally situated loops with arterial branches so fine that only the larger venous limb may be easily visible, and thus the erroneous impression of a single vessel projection instead of a loop may be produced (fig. 12).

#### OCCURRENCE

During the summers of 1940 and 1941, in 642 patients of the Birmingham Nutrition Clinic, who had deficiency diseases of varying degrees of severity, 85 were observed to have concentric collaterals but not a single case of corneal vascularization in the absence of previous corneal disease, as evidenced by infiltrations, ulcers, or scars, was seen. These observations are in accordance with those of Julianelle and Lamb,<sup>16</sup> who found capillary branches budding off from the limbal loops and running between the corneal lamellae only where foci of necrosis were present, and with the findings in pathologic conditions of the cornea in general. Also in interstitial keratitis, corneal disease precedes any vascularization (Duke-Elder).

In the Birmingham group the in-

cidence of concentric collaterals was about 13.3 percent.

The youngest patient manifesting concentric collaterals was seven years old, but it was not always possible to examine younger children with the corneal microscope. The oldest patient in this group was 66 years old. There were 11 patients less than 16 years of age, 26 patients between 16 and 50 years and 7 patients older than 50 years.

#### ANALYSIS OF 44 CASES WITH CONCENTRIC COLLATERALS

Between April 26 and July 14, 1941, more exact studies were made on 44 patients, 4 of whom had shown concentric collaterals the previous year. Of these 44 patients chosen at random, 13 were male and 31 female. A diagnosis of vitamin deficiency was made by the physicians of the Nutrition Clinic. The following types of deficiency diseases were found:

Riboflavin deficiency .....	12 instances
Nicotinic acid deficiency .....	13 instances
Thiamin deficiency .....	2 instances
Subclinical deficiency .....	8 patients
Questionable or no deficiency .....	13 patients

No amount can be calculated from these figures which, in part, correspond to single individuals and, in part, to kinds of deficiency that may overlap in one and the same person.

Four patients were addicted to alcohol; two had pulmonary tuberculosis; two had acne rosacea; and in one 13-year-old girl who had enormous follicular conjunctivitis a severe vulvitis was found. The presence of Bitot's spots was observed in four patients, in two of whom they were bilateral.

As to the history of these 44 patients, 32 were aware of signs and symptoms of conjunctivitis. Some stated that the recurrences of these symptoms coincided with recurrences of stomach disorders.

Photophobia was present in more than

one half of the patients (24), and hemeralopia in about one fifth of them (9).



Fig. 12 (Vail and Ascher). Enlarged reproduction from the photo chrome picture\* of the right eye of Lucille Fr., white girl, aged 14 years. Diagnosis of the Nutrition Clinic: no definite deficiency. When this picture was taken, her conjunctivas did not show any recent inflammatory changes except a slight nasal thickening of both bulbar conjunctivas; she gave a history of previous eye trouble such as watering and redness. In spite of her youth, an incipient pinguecula was present temporally from the cornea of the left eye. In the bulbar conjunctivas hyaline and calcareous deposits were found on biomicroscopy. Lacrimation was rather quick (Schirmer's test, 22-55). Corneal hyperesthesia was present. This patient was observed for more than nine weeks—May 17 to July 24, 1941—and it seemed that during July the concentric collateral became fuller and that some distal loops became filled just during that month. The arrow indicates one recently filled arcade situated closer to the corneal center; this loop, as well as the whole concentric collateral, consists of engorged parts of the preformed limbal meshwork, which in young people tends to be more extensive than in later life. In this illustration, light reflexes interfere with the visibility of parts of the vein draining the concentric collateral.

Objectively, none of these 44 patients was entirely free from conjunctivitic signs, as is shown in the following table:

	<i>Patients</i>
More or less marked injection of all parts of the conjunctiva .....	23
Injection confined to the exposed region of the bulbar conjunctiva .....	17
Papillary hypertrophy of the tarsal conjunctivas .....	22
Congestion of semilunar folds .....	13

\* Taken by Dr. Mann, of Cleveland, in July, 1941.

Follicular hypertrophy .....	12
Isolated thickening of nasal bulbar conjunctiva .....	11
Slight conjunctival discharge .....	8
Abundant conjunctival discharge .....	4

In 5 of the 12 patients with follicular conjunctivitis, the follicular hypertrophy was very extensive, including parts of the bulbar conjunctiva and of the semilunar fold. Pannus and tarsal scars were not found in these patients. Only one of them had small scars in his upper tarsal conjunctiva but no pannus.

Isolated thickening of the nasal bulbar conjunctiva was present in one fourth of the 44 cases studied intensively, but occurred in less than one sixth of the 642 patients.

The following changes were observed in the cornea:

	<i>Patients</i>
Bilateral superficial keratitis .....	2
Corneal scars of different types .....	7
Rapidly drying areas of exposed corneal epithelium .....	4
Bilateral pterygium .....	4

Superficial keratitis occurred in only 3 of 642 patients; in the group exhibiting concentric collaterals, keratitis was markedly higher, being present in 2 of 44 patients. Pterygium was observed in 8.23 percent of the whole group of patients. It occurred in one eleventh of the cases with concentric collaterals.

Corneal sensitivity was tested in 25 patients of this group. Three of them had hypoesthesia and two hyperesthesia of both corneas.

On biomicroscopic observation, 31 patients showed deposits in the bulbar conjunctivas, and 18 patients had pingueculae, which were chiefly bilateral. The conjunctival deposits were:

	<i>No. of Patients</i>
Quartz-gravellike, hyaline .....	27
Roundish, yellowish, probably the "fatty spherules" of Vogt .....	2
Grayish tuff-stonelike, probably calcareous .....	2

The high occurrence of pingueculae and of peculiar deposits in the bulbar conjunctiva of the patients observed in Birmingham has been striking since the introduction of biomicroscopic eye observations in the summer of 1940.

Special attention was directed to the limbal loops in the region where concentric collaterals had not absorbed their individual existence. In these 44 patients—

	<i>No. of Patients</i>
The limbal loops were well filled .....	11
The limbal loops were partially filled ..	11
No unusual appearance was noticeable	22

This fact is further evidence that intensity and extent of hyperemia in the limbal meshwork are somewhat independent of each other.

While the concentric collaterals occurred more frequently (in 25 patients) in both eyes, and in more than one quadrant of each of them, there were 19 cases exhibiting unilateral concentric collaterals only. It would seem that in these unilateral cases antecedent conjunctival disease is developed more on the side where the collateral is present, but further repeated observations should be made before definite conclusions can be drawn.

There is an interesting difference in the frequency of location of the concentric collaterals. While the localization in the upper half occurs 4½ times more frequently than that in the lower half, localization in the nasal limbus was 5½ times as frequent as it was in the temporal. This difference is not due to the manner of investigation, since in the usual position of the movable slitlamp arm, the nasal limbus is more easily seen in retroillumination than is the temporal limbus. Errors were avoided by frequent observation with the slitlamp arm swung to the nasal side of the observed eye, instead of the usual temporal position. Moreover, the

appearance of concentric collaterals was, after a short time, so familiar to us that we could recognize them readily with direct illumination. Accordingly, there must be other reasons for the prevalence of the localization of concentric collaterals in the upper and in the nasal half of the limbus.

#### ANALYSIS OF 69 CASES OF CONCENTRIC COLLATERALS SEEN IN THE CINCINNATI EYE CLINIC

In the spring of 1942, 69 patients of the Out-patient Department of the Ophthalmic Department, College of Medicine, University of Cincinnati, were examined with respect to their limbal and corneal vascularization. These patients were selected at random from the refraction cases and from the clinic. Acutely inflamed eyes and those with corneal disease were excluded. Investigation by means of the corneal microscope was made with the slitlamp arm swung in the position that allowed retroillumination of the limbus under observation. Three degrees of limbal vascularity were distinguished: degree 1, well-filled limbal loops; degree 2, incomplete concentric collaterals (fig. 8); and degree 3, complete concentric collaterals. Each quadrant of any cornea was registered separately in a kind of punch-card system showing eight squares for each patient. These squares corresponded to the nasal and temporal, upper and lower, quadrant of the right and of the left eye, respectively. Using the figures 1, 2, or 3, we recorded the highest degree of vascularity observed in the particular quadrant. Eyes with at least one quadrant showing degree 3, or at least two quadrants showing degree 2, or with four quadrants showing degree 1, were considered to be positive. Filling of a few unconnected limbal loops may be found in any eye, and was considered, in accordance with Vogt and Duke-Elder, as a normal finding.

The individual records for single patients contained, besides the number and name, mimeographed categories for noting race, sex, age, general and ocular diagnosis. Further categories included a description of the lids, lacrimal apparatus, tarsus, fornix, semilunar fold, bulbar conjunctiva, cornea, discharge. Spaces for history were provided, and special regard was directed to photophobia, hemeralopia, and paresthesias.

The patients were investigated and the findings recorded without any questioning as to dietary habits. These facts were recorded by another person\* in our absence. Attention was given to the intake of food rich in vitamins. Patients drinking at least two pints of milk daily, eating at least two helpings of vegetables or potatoes daily, at least one egg and one square of butter daily, carrots at least once a week, fruits at least once a day, and meat daily were considered to have an adequate vitamin intake.

Persons with an intake of less than half a pint of milk daily, less than one egg daily, less than one square of butter daily, less than one vegetable plate daily, and meat less than three times a week were recorded in the group of poor diets. Among 69 patients, 24 belonged to the group receiving a good diet, and 28 to that on a poor diet, whereas 17 were left to make up a group getting a medium diet. As far as possible utilization and requirements were considered.

Thirty-one among 69 patients showed typical complete concentric collaterals in one or both eyes. Six others showed a larger amount of incomplete concentric collaterals or limbal loops filled to a high degree. Thirty-two patients showed only a few or no limbal loops filled with blood.

Among 37 patients with concentric collaterals or markedly filled limbal loops,

\* We are greatly indebted to Mrs. Elizabeth Ascher for her unselfish collaboration.

25 displayed this sign in both eyes, whereas 12 showed it unilaterally.

The age limits of the whole group were between 7 and 80 years, as follows: 30 patients up to 15 years of age, 19 patients between 16 and 30 years, 13 patients between 31 and 50 years, and 7 patients older than 50 years.

The following table shows the distribution of ages in the positive and in the negative group:

Age	AGE GROUPS	
	Positive Cases	Negative Cases
Up to 10 years ..	4	4
Up to 15 years ..	8	13
Up to 20 years ..	8	3
Up to 30 years ..	7	1
Up to 50 years ..	5	5
Up to 80 years ..	5	6

So far as the race is concerned, the distribution of positive and negative cases was as follows:

	Positive Cases	Negative Cases
White race ....	27	12
Black race .....	10	20

As to sex, 23 patients were male and 46 female. The distribution of positive and negative cases according to sex is shown in the following table:

	Positive Cases	Negative Cases
Males .....	9	14
Females .....	28	18

The following table shows the distribution of the concentric collaterals over different limbal regions. Concentric collaterals and extensive limbal loops were observed in 37 patients (62 eyes), showing this vascularity.

	Times
The nasal limbus was involved .....	57
The temporal limbus was involved .....	28
The upper limbus was involved .....	52
The lower limbus was involved .....	42

The distribution of positive and negative cases in the dietary groups was as follows:

	Diets		
	Good	Medium	Poor
Positive cases .....	14	12	11
Negative cases .....	10	5	17
Positive bilateral .....	10	10	5
Positive unilateral .....	4	2	6

In a distribution similar to that observed in the cases in Birmingham, the Cincinnati patients showed slight conjunctivitic signs in those eyes that had concentric collaterals. Here again the tarsal conjunctivas were almost always involved, whereas the bulbar conjunctiva and semilunar fold showed injection only in about one half of the patients with concentric collaterals.

COMMENT

Sydenstricker's illustrations, as well as his descriptions, suggest that what he termed corneal vascularization is nothing more than extensive engorgement of the preëxisting limbal meshwork except in cases of obvious corneal disease. This interpretation seems to be contradicted by Sydenstricker's observations that the corneal vascular plexus formed in cases of ariboflavinosis may cover the peripheral two thirds of the cornea. So extensive a vascular plexus has not been observed in the patients in the Nutrition Clinic in Birmingham, nor among the patients studied in Cincinnati. Local environmental conditions might be responsible for this difference. In regard to the singularity of so extensive a vascular proliferation, two possible sources of error should be considered: the occurrence of nebulæ in these corneas, mentioned by Sydenstricker, is an indication that before these scars could have been formed keratitic changes of either infiltrative or ulcerous character must necessarily have preceded the formation of the nebulæ. Once keratitic changes appear, the new formation of capillaries sprouting off from the limbal loops is understandable. On the other hand, in comparing the extension of any

involvement of the corneal limbus with the unaffected corneal tissue, especially when higher-power magnification is used, the vascularity might be overestimated.

The fact that Sydenstricker observed "the normal avascular zone between the plexus and the sclerocorneal junction overrun by minute vessels" explains the difference between Sydenstricker's point of view and our own. Knowing that there is no "normal avascular zone" between the plexus and the sclerocorneal junction, but a definite vascularity normally present over the entire limbus, we cannot agree with his conception that visible vessels in this region constitute "vascularization."

The anatomic situation in the conjunctivoscleral wedge favors a striking transilluminability of this region when observed with retroillumination. Observed by this means, concentric collaterals contained in the tissue overlapping the corneal rim appear to be situated in the cornea proper and may be mistaken for real corneal vascularization when they are merely a special kind of engorgement in the marginal meshwork (figs. 1 and 15).

It is probable, although not absolutely certain, that there is a causal relation between the situation of the concentric collaterals and that of chronic inflammatory conjunctival changes. In spite of the distance between the limbus on one side and the semilunar fold and upper tarsus on the other side, persistent or marked inflammation in these latter parts may have some bearing on the greater frequency of concentric collaterals in limbal areas adjacent to these regions. As a rule, papillary hypertrophy is seen more frequently in the upper than in the lower bulbar conjunctiva; the semilunar fold is sometimes the only part of the conjunctiva showing injection for a long time after other parts have resumed their normal color. The adjacent area of the nasal bulbar conjunctiva is more prone to develop

the isolated thickening that probably is a sign of mild chronic inflammation; pterygia, too, are more often situated in the nasal than in the temporal limbus. Without drawing unfounded conclusions, we may say that the nasal part of the limbus is, for certain pathologic changes, an unquestionable locus minoris resistentiae as compared to the temporal limbus. The same may be true, to a certain degree, of the upper limbus as compared to the lower limbus; here may be mentioned the typical occurrence of trachomatous pannus in the upper corneal area.

An explanation of the engorged limbal loops and the associated concentric collaterals was attempted (Sydenstricker, Johnson) by assuming that "corneal vascularization" is due to lack of the oxygen carrier, and more blood has to be brought to the tissues that are poor in, or entirely devoid of, respiratory ferments. According to Johnson, proliferation of capillaries from the limbus would appear to be an effort to combat localized anoxemia by bringing hemin substances into closer proximity to the tissue. He believed that regression of the corneal vascularization follows riboflavin sufficiency and the restoration of the yellow-enzyme system to its normal position in oxidation.

In a recent and as yet unpublished study on corneal disease in vitamin deficiency the doubt is expressed as to whether increased blood supply might help the respiration of a tissue lacking in the oxygen carrier. However, this objection does not cover the case of partial deficiency of the oxygen carrier; in this condition, increased blood supply might be of value in insuring better respiration. As the result of experiments on rats with riboflavin deficiency Johnson and Eckhardt<sup>3</sup> stated that covering of the cornea with ointment or liquid petrolatum does not hasten vascularization, and hence they conclude that the vitamin itself or the oxi-



dative enzyme derived from it, if deficient, is the major factor in producing vascularization of the cornea in the rat. In the opinion of these observers this experiment supports the assumption of anoxemia as the ultimate cause of capillary proliferation.

Another point to be considered is the following: In the limbal area of human eyes with engorged limbal loops, and even more in those with concentric collaterals, a bright red color, which would indicate the presence of an active hyperemia, is almost never seen. On the contrary, the limbal zone appears dark red or violet, in spite of the absence of a typical deep (ciliary) injection. This dark-red color is due to the venous qualities of the blood present in the loops under discussion. There is more stasis due to engorgement and less or no active afflux, which latter should be expected if and when a greater demand for oxyhemoglobin were present and satisfied. This is the more remarkable in view of the usually bright color in all superficial conjunctival vessels, a fact that interferes with a color differentiation between arterial and venous vessels in this region. Whether this equally red color is due to a possible oxygen intake and carbon-dioxide elimination via the vessel wall and conjunctiva is an interesting question. Two other possible explanations for the normal bright-red color in all superficial vessels are rejected. There is in this region neither a low metabolism nor is the speed of the blood current so high that venous qualities could not become obvious in the blood returning from the arterial limbs of the limbal meshwork.

If visible at all, the current in the concentric collaterals is usually slow, especially in cases of incomplete collaterals. Where a collateral covers a complete quadrant, the blood current may be, but often is not, more rapid. Dilution by clear fluid leaving the aqueous veins<sup>11</sup> could be

responsible for the bright color sometimes noticeable in these veins. In this case it would not be caused by the presence of oxyhemoglobin, but by the influx of fluid free from red blood cells.

Whatever the answer to this particular question may be, the expression "corneal vascularization" should never be used for a condition brought about by a dilatation of preëxistent pathways and not by the formation of new vessels. Repeated examination of the Birmingham and Cincinnati patients who had engorged limbal loops and concentric collaterals led us to the opinion that these are not newly formed vessels. An explanation which does not exclude the biochemical point of view, but which is primarily based on considerations of the local vascular anatomy and of the mechanism of blood circulation in the limbal region, appears logical.

After the summer of 1940, visitors to the Birmingham Nutrition Clinic, as well as members of its staff, were shown that the obvious situation of congested limbal loops and of concentric collaterals is in the semitransparent, scleroconjunctival limbal zone, which, under indirect illumination, can be mistaken for a part of the corneal tissue proper, whereas direct illumination shows its continuity with the opaque bulbar coat and the vascularity of the latter (figs. 1 and 13).

Concentric collaterals should be understood as a sequela of an extensive conjunctival congestion of long duration or of repeated occurrence. Whether this conjunctival disturbance is or is not due to vitamin deficiency is another question. The deficiency may be assumed as the main cause or as an additional cause combined with other noxious factors, as microbial or virus infection or exposure to dust, wind, heat, or to certain irradiations, in order to produce the conjunctival disturbance responsible for the formation of



concentric collaterals. Any form of conjunctivitis may lead to congestion in the limbal meshwork, and the more severe it is, the greater the involvement of the bulbar conjunctiva.

The vessels of the bulbar conjunctiva are imbedded in very soft tissue; the closer the vessels are to the limbus, the more firm is the tissue surrounding them. Near the limbus, conjunctival vessels are less movable, and, probably, more resistant to dilatation as well as to collapse. The latter fact is of high physiologic value because of the presence in this region of vital connections between Schlemm's canal and extraocular vessels.

Pathologic conjunctival injection of the bulbar conjunctiva is described as being less marked in the pericorneal region than in the periphery. This fact can be explained by the presence of the most obvious pathologic changes in the tarsal conjunctivas and in the fornices, and to the gradual diminution of injection in the adjacent bulbar conjunctiva. It could also be due, however, to a higher resistance to dilatation in the firmer tissue around the limbus. On the other hand, any congestion in the bulbar conjunctiva of higher degree or of longer duration may finally lead to a dilatation even of vessels situated in a more resistant tissue (figs. 18 and 19).

Such dilatation is probably not a purely passive one, but may be combined with such changes as cellular proliferation in the vessel wall, as suggested by the fact that, on biomicroscopic examination, the individual vessel section finally appears to be two or three times larger than normal loops in this region. We must consider that the surface of a cylinder varies in proportion to its diameter. It is not probable that such an amount of increase could be covered by mere stretching (fig. 15).

For development of these anatomic changes in the limbal vessels, some time

is needed. For this reason concentric collaterals do not appear in cases of acute conjunctivitis of short duration even when there is an intense limbal hyperemia, and a certain time must elapse before concentric collaterals become visible in processes of longer duration. After engorgement of low degree or of short duration, single limbal loops become dilated before connection by collaterals takes place. The

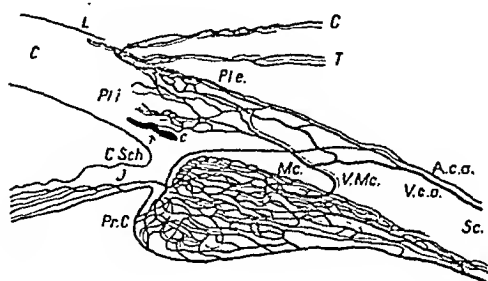


Fig. 13 (Vail and Ascher). Schematic cross section of the anterior segment of the human eye, showing the peripheral corneal rim overlapped by the limbal meshwork.\*

same phenomenon may become visible when the etiologic process is receding and the collateral splits off again into single loops (fig. 14). It is obvious that it is not only inflammation that may produce concentric collaterals in limbal meshwork, but any other conditions leading to repeated or long-standing congestion in conjunctival vessels may have the same effect. Tumors or irradiation by roentgen rays or radium may produce similar results.†

An analogy to the formation of concentric collaterals can be found in the human retina after obstruction of branches of the central vein. In the retina, mere inflammation does not produce collateral circulation because of the numerous an-

\* Taken from Duke-Elder's "Textbook of ophthalmology," volume 1, page 138, in which it was reproduced from L. Maggiore.

† Concentric collaterals often appear in the limbus where it is adjacent to a chalazion; in these cases, other parts of the limbus that are not irritated by the chalazion do not show the concentric collaterals, neither does the fellow eye when free from congestion.

astomatic pathways available. Collaterals will be formed, however, after thrombotic occlusion. Michaelson and Campbell<sup>17</sup> concluded, from studies of the retinal capillaries, that the anatomically preformed capillary branchings form a sufficient basis for the winding collaterals which appear

particular portion of the capillary bed may drain into several veins that are distant from one another. In this way these authors explain the wide wanderings of the new channels, and they reject the assumption of reserve capillaries in the retina.

A similar explanation for retinal collat-

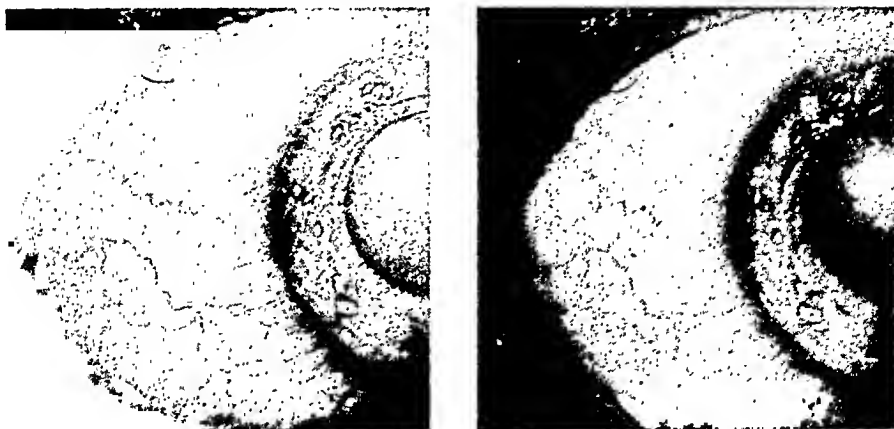


Fig. 14 (Vail and Ascher). Stereophoto showing single dilated loops in the left nasal lower limbus of Harold All., white boy, aged nine years. Diagnosis of the Nutrition Clinic: riboflavin deficiency. The patient had cheilosis. His eyes had been red for two months, and he complained of headache and flickering before his eyes, burning, watering, and defective vision of the right eye.

There was a concomitant convergent strabismus of the right eye. This eye had a hyperopic astigmatism of six diopters, with one diopter more in the horizontal meridian and a congenital glial hyperplasia of the disc of the right eye. The left eye showed a hyperopia of two diopters only.

At the time of his admission, on June 16th, there was a moderate but rather extensive injection of limbal loops in both eyes. Injection of the exposed regions of both temporal halves of the bulbar conjunctiva was present, with slightest epithelial stippling in this region. The corneal sensitivity was reduced in the corneal tissue adjacent to this episcleritic area.

There was a spontaneous subsidence of the injection between June and August, 1941. The extensive limbal loops did not disappear during this time, nor after intravenous injection of 5 mg. of riboflavin on August 7th and 8th.

after occlusion of a retinal venous branch. These investigators assert that it is unnecessary to invoke new budding of endothelial tubes. It is known that all capillaries are capable of undergoing hypertrophy to an enormous extent. Moreover, vessels not much larger than capillaries can normally drain directly into the largest veins. According to Michaelson and Campbell, these two facts are sufficient in themselves to explain the development of the collateral channels. A

erals was given by Elschnig<sup>18</sup> as early as 1898. Not only is his picture similar to that of Michaelson and Campbell, but his explanation also refers expressly to dilatation of preëxistent capillary connections, and the term "collateral ways" is used.

On the other hand, once stabilized, anatomic changes will not recede immediately after the cessation of their cause, and this fact explains the persistence of concentric collaterals—and of other forms of vascu-

lar dilatation, such as single limbal loops and aneurysms—after disappearance of the causative factor.

This kind of vascular reaction, slow dilatation, and slow or absent recovery is sometimes present in other parts of the conjunctiva. Injection and papillary hypertrophy develop slowly in the tarsal conjunctiva, for instance, in cases of lacrimal stenosis, and it takes them a long time to disappear after a successful dacryocystorhinostomy.

Papillary hypertrophy is, of course, not an exact analogy to limbal concentric collaterals, but in both cases conjunctival vessels are situated in a firmer tissue and a longer time is needed to reduce the changes produced in these regions than in the soft bulbar conjunctiva. In both conditions not transient functional but durable anatomic changes are present.

Upon observing many cases of concentric collaterals, one may say that their formation indicates the degree of congestion in the limbal meshwork that was present during a previous pathologic condition. The more congestion, the more dilatation takes place, and the closer it will progress to the corneal rim of the scleroconjunctival wedge. They are genuine collaterals (figs. 15 and 19). Thus, the concentric collaterals form a sort of flood mark indicating the level of the flood after the river itself has regained its former level.

Sometimes the corpuscle content of the concentric collaterals is very low. Even collaterals apparently free of corpuscles are seen. Whether these are to be considered as "emptied" vessels, and just about to be put out of use upon regression of the causative condition, or whether the low blood corpuscle content can be explained by the influx of aqueous veins<sup>11</sup> pouring clear fluid into the prepared vessel bed, can be judged only in each individual case. Seasonal differences are to

be considered, but so far there is no convincing evidence of a periodic seasonal filling and emptying of these vascular structures.

Concentric collaterals never should be considered as an isolated or independent vascular phenomenon; they are under-

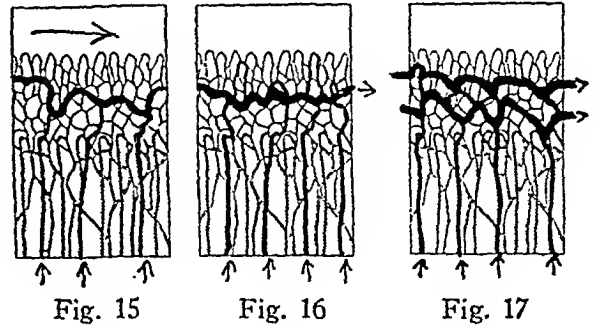


Fig. 15

Fig. 16

Fig. 17

Figs. 15, 16, 17 (Vail and Ascher). Concentric collaterals.

Fig. 15 shows a part of a primary concentric collateral. There is a low intensity of limbal injection, but a higher extent in the direction toward the corneal center, and a marked dilatation of the distal area. All blood is collected by the concentric anastomosis.

Fig. 16 shows a concentric collateral in progression. Distally situated loops become filled; there is a higher degree of extent in the limbal injection. All blood returns by the primary concentric collateral.

Fig. 17 shows a part of a double concentric collateral. A secondary anastomosis has formed distally from the primary anastomosis. No venous return along the original efferent limbs; all blood is collected by the double collateral, which finally empties into the horizontal meridian vein.

standable only on the basis that they are a part of the whole bulbar conjunctival vascularity anatomically as well as functionally.

When the etiologic condition continues, or even increases, more loops are filled with blood. This does not mean loops that are newly formed, but loops that were not previously engorged. Thus, little extensions or protuberances will appear distally from the original concentric collateral (figs. 9, 16, 17). Later on these extensions join a more advanced concentric collateral, while the older, more proximal one, may

persist or may be reduced in caliber.

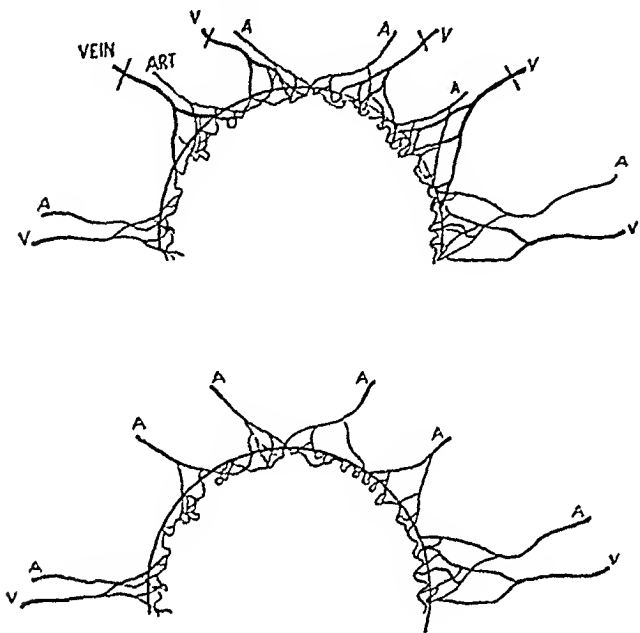
In recent publications, an old mistake reappears which seems to have been eliminated as a result of the argument between Augstein<sup>19</sup> and Stargardt.<sup>20</sup> Using a 10 $\times$  magnification, Augstein described capillary sprouts in the limbal meshwork the existence of which was definitely refuted by Stargardt. Using the binocular micro-

seen. Nor has our material yielded any evidence of capillary sprouts with a dead end.

The new concentric collateral has, as a rule, the same direction that the older one had. In a concentric collateral situated in a quadrant of the upper limbus there is almost always a downward direction of blood flow and vice versa. Exceptions to this rule are an extreme rarity, and then they are apparently due to some local impediment in the usual direction of the current. In old concentric collaterals reversed current may occur, according to the changing conditions of pressure potential in different parts of the limbal meshwork. This phenomenon seems to be an indication of impending retrograde involvement of the concentric collaterals, which, in this case, will be split up again into single limbal loops.

After compression of the carotids of a patient with general hypertension, Rollin<sup>21</sup> observed a change in direction of flow in the limbal capillaries. He did not describe a formation similar to the concentric collaterals. His findings, however, indicate the relation of the direction of the current in the limbal meshwork to intravascular pressure changes.

Johnson<sup>4</sup> interprets the development of what we call concentric collaterals in the following words: "Early in their development these vessels are capillary loops, exceedingly rich in Rouget cells, as judged by the marked variation in caliber of vessels, some capillaries being exceedingly small and others markedly engorged with cells. In long-standing disease the vessels tend to lose this characteristic, and appear to acquire something of a vessel wall. It then becomes more difficult to follow them as individual loops." We believe that



Figs. 18 and 19 (Vail and Ascher).

Fig. 18, a schematic drawing showing the development of a concentric collateral. Engorgement in the veins A and V is responsible for an eventual change in the original direction of the limbal circulation.

Fig. 19 shows collateral veins accepting all blood, which now returns along the dilated collateral pathway.

scope or Czapsky and 35 $\times$  magnification, Stargardt was always able to see the afferent and the efferent limb of what seemed to be, on superficial examination, a freely ending single capillary sprout. The connection between afferent and efferent limbs, estimated by him to have a diameter of only 5 $\mu$ , might have escaped the attention of Augstein as well as that of recent observers. Stargardt investigated more than 200 cases with pathologic corneal vascularization, and even in these cases single capillary sprouts were never

the main difference between Johnson's and our own conception is that Johnson did not differentiate between congestion in anatomically preformed limbal loops and real vascular proliferation. This differentiation may be of help particularly in the understanding of the concentric collaterals as derivatives from preëxistent but actually dilated pathways of the limbal circulation.

In a recently completed but not as yet published study concerning aneurysms of the bulbar conjunctiva the incidence of concentric collaterals in the group of cases with aneurysms was found to be about 1 to 10. A mechanical explanation of the dilatation of the vessels seemed in many of them to be obvious. There is often a crossing of the aneurysmic vessel by another vessel, and thus, by compression, a local engorgement and subsequent dilatation may be produced (fig. 20). Aneurysms are found in afferent as well as in efferent limbs of limbal loops (fig. 21) in adjacent arterioles or venules.

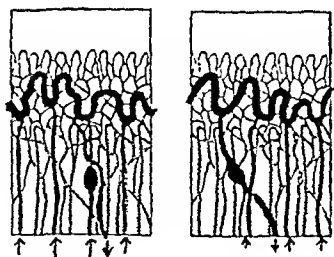


Fig. 20

Fig. 21

Figs. 20, 21 (Vail and Ascher).

Fig. 20, aneurysmatic dilation of an afferent limb.

Fig. 21, aneurysmatic dilation of an efferent limb.

The foregoing statement does not imply that all aneurysms of the bulbar conjunctiva can be explained by mechanical obstruction and consequent increase of the diameter in a circumscribed part of the vessel.

No changes in limbal concentric collaterals were noted after repeated admin-

istration of 2, 3, and 5 mg. of riboflavin. Even single, and unconnected, limbal loops often did not disappear after most intensive riboflavin therapy in spite of the simultaneous clearing up of the bulbar conjunctiva. Observations of this kind suggest the assumption that anatomic changes in these loops have taken place due to a previous long-standing engorgement, as discussed elsewhere, and again justify the differentiation between the conceptions of the extent and intensity of limbal hyperemia. The intensity of limbal hyperemia may be reduced by riboflavin administration, whereas the extent of limbal hyperemia apparently is not so influenced.

In the patients observed in the Cincinnati Eye Clinic, the percentage of eyes with concentric collaterals was markedly higher than in the Birmingham subjects. Patients visiting the Out-patient Department of the Cincinnati General Hospital belong to a low-income group. We would expect, however, that, in case of a vitamin-deficiency etiology, the frequency of concentric collaterals should be higher in patients of the Nutrition Clinic in Birmingham, where deficiency is believed to be endemic.

There are other differences between the Birmingham and the Cincinnati group. In Birmingham, for example, Negro patients were a rare exception, whereas in the Cincinnati group the number of white and of colored patients observed was about equal. In Negro eyes, pigmentation in the limbal region sometimes interferes with the visibility of the limbal loops. Thus, it could be possible that more eyes in the Cincinnati group had concentric collaterals which, however, were not detected due to the racial pigmentation.

The frequency of concentric collaterals in white and colored persons was reciprocal: about two thirds of the observed white patients had concentric collaterals,

while only four sevenths of the colored patients gave positive findings. Whether this difference may be due to the limbal pigmentation or to other causes is an open question.

A definite difference in the distribution with regard to sex was obvious in the Birmingham as well as in the Cincinnati material. The proportion of positive and negative cases in the male group was about equal to one to two. In the female group, this proportion was about three to two.

A predominance of the nasal and of the upper limbal region was present in both the Cincinnati and the Birmingham groups. The nasal limbus was involved twice as often as the temporal limbus. The proportion of the involvement of upper and lower limbus was about equal to five to four.

The distribution of positive and nega-

vascularity. Among 14 patients with adequate diet, 10 had bilateral and 4 unilateral concentric collaterals. Among 11 patients with poor diet, 5 bilaterally positive cases and 6 unilaterally positive cases were found.

In the group of those having an inadequate diet there were seven patients receiving an extremely poor diet. As an example, William Sh., aged 58 years, should be mentioned. This man could get a glass of milk only once or twice a week; about twice a week he ate an egg; twice a week he had potatoes; sometimes he ate cabbage and beans; fruits rarely, meat once daily. He did not show concentric collaterals, not even the slightest congestion in the limbal meshwork. Three more patients who were on a very poor diet showed no concentric collaterals. Three patients with a diet similar to that of William Sh. had the following distribution:

DISTRIBUTION OF CONGESTION OVER THE LIMBAL QUADRANTS

Name of Patient	Age, years	Right Eye		Left Eye		Quadrants
		Temporal	Nasal	Nasal	Temporal	
Katherine M.	16	3	3	3	0	upper
		0	0	0	0	lower
Dolores H.	10	2	2	0	0	upper
		0	0	0	0	lower
Richard H.	8	0	0	3	0	upper
		0	0	3	0	lower

- 0 means a few visible limbal loops.
- 1 means numerous well-filled loops.
- 2 means incomplete concentric collateral.
- 3 means complete concentric collateral.

tive cases as to the dietary groups gives definite proof that so-called corneal vascularization has no bearing on dietary habits. In the group of patients receiving proper diet, the proportion of positive and negative cases was 14 to 10. In those in the deficient-diet group this proportion was 11 to 17. Even the distribution of unilateral and bilateral involvement in the positive cases is far from suggesting any relationship between nutrition and limbal

In the cases of those with good diet and highly developed concentric collaterals the objection could be made that, in spite of an adequate intake of vitamins, the failure to utilize them might have produced deficiency. No similar objection is possible with regard to patients on an obviously inadequate diet having limbi free of vascular engorgement.

In one of the Cincinnati cases, Betty Gl., aged 16 years, a combined intrave-

nous and oral riboflavin administration did not induce any change in the considerably filled limbal loops.

#### SUMMARY

Concentric collaterals are engorged parts of the preëxistent limbal meshwork. Their function is to collect blood from all limbal loops of one entire limbal sector, or a part of them, and to return this blood from the limbus to the larger conjunctival veins.

These vascular anastomoses are optimally visible by retroillumination. They occur in a percentage of 13.3 in a group consisting of persons with manifest or subclinical or suspected vitamin deficiency observed in the Nutrition Clinic in Birmingham, Alabama. Among 69 persons observed in the Eye Clinic in Cincinnati, almost one half had concentric collaterals.

Concentric collaterals should not be mistaken for corneal vascularization. So long as definite pathologic corneal processes are absent, corneal vascularization never takes place, and even very intensive and extensive engorgement does not suffice for trespassing upon the anatomically preformed limbal meshwork. The situation of the concentric collaterals in the cornea proper is only apparent and not real, due to the fact that in the corneal periphery the conjunctivoscleral zone containing these vessels overlaps the corneal rim.

Concentric collaterals, when fully developed, run from the 12- to the 3- or 9-o'clock position, and from the 6- to 3- or 9-o'clock position. As a rule, all concentric collaterals in the upper limbus show a direction of flow downward until they reach the horizontal meridian, and vice versa.

Composed of limbal loops, they usually turn small convex arcs toward the cornea proper; new extensions produce a concave appearance so long as a more cen-

tral collateral does not develop. Progression always occurs in loops, never in single vessels.

Any kind of long-standing engorgement in conjunctival vessels may induce the formation of concentric collaterals. So far as their developmental mechanics are concerned, they probably are due to a hindrance of venous outflow from the immediately corresponding venous limb, and are to be understood as a kind of collateral circulation leading to the conjunctival veins in the horizontal meridian because of overcrowding in the original venous drainage. This cannot be achieved without dilatation of the particular loops that have to form the new detour. It takes time for this dilatation to develop. It probably is connected with cellular changes, and is not due to a mere stretching of the vessel wall. This fact, on the other hand, interferes with an early reduction of the collateral way, if once formed; the dilatation of these vessels persists after disappearance of the provoking cause.

In a similar way, after engorgement of lower degree or of shorter duration, dilated single loops may be observed around the corneal limbus. They probably are forerunners of concentric collaterals and are as uncharacteristic of vitamin deficiency or of a certain type of vitamin deficiency as are the developed concentric collaterals.

After the formation of one concentric collateral, repeated or prolonged engorgement may produce another concentric collateral, located closer to the corneal center and showing the same direction of flow as did the first collateral.

The occurrence of engorged limbal loops and concentric collaterals in the Birmingham as well as in the Cincinnati patients was more frequent in the female sex and was distributed over all age groups. From these cases no relationship can be deduced between any particular



type of vitamin deficiency and concentric collaterals.

All Birmingham patients gave a history of, or exhibited signs of, repeated conjunctivitis; none of their eyes was free of chronic conjunctivitis. Some of these patients were addicted to the use of alcohol. Pingueculae and hyaline deposits in the bulbar conjunctiva were very frequent in the eyes of these patients, even in young subjects. There seems to be a relation between the most marked conjunctival changes and the location of concentric collaterals.

Among 69 cases selected at random in the Cincinnati Eye Clinic there were 37 patients with congestion in the limbal region, 31 of whom showed typical concentric collaterals. The female sex predominated in the positive group. The per-

centage of positive eyes was higher in white than in Negro patients. The nasal limbus was involved more often than the temporal limbus, and the upper limbus more often than the lower limbus.

There was no relationship between the dietary habits and the frequency of vascular congestion in the limbal region. The number of positive cases was higher in the good-diet group than in the poor-diet group. Even the number of bilateral cases was higher in the group of well-nourished patients.\*

Although in the Birmingham group, consisting of patients with manifest, sub-clinical, or suspected vitamin deficiency, about one eighth of all cases observed showed concentric collaterals, in the Cincinnati group more than one third of all cases exhibited this sign.

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\* In recent vitamin advertisements it is frequently suggested that a normal bulbus does not show any blood vessels—pictures of eyes with an entirely white bulbar conjunctiva are reproduced as normal eyes. Such an eye, however, could be only that of a corpse or of a patient with a very severe anemia. Neither physicians nor the public should be misled into believing that any vascularity visible in the bulbar conjunctiva is necessarily pathologic.

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# INTRAOCULAR INJECTION OF SULFANILAMIDE IN A CASE OF PURULENT IRIDOCYCLITIS\*

JOSEPH IGRSHEIMER, M.D.

*Boston*

Injection of sulfa drugs into the anterior chamber of a human eye has, so far as I know, not been attempted previously. It is not the purpose of this short article to advise that this treatment be followed as a frequent procedure. But in special cases one may try it and perhaps achieve as miraculous results as were obtained in the case hereindescribed.

## CASE REPORT

Edward S., aged 12 years, was first admitted to the hospital on March 30, 1942, and discharged on May 16th of that year.

Two days before his admission the patient had been struck in the right eye by glass, following an explosion of a bottle of water.

*Examination.* Vision in the right eye was light perception. There was an irregular central laceration of the cornea. The anterior chamber was formed, a hypopyon in its lower quarter. There was a thick fibrinous exudate extending from the posterior surface of the cornea to the pupillary opening. The pupil was contracted, the iris congested. The fundus could not be seen.

*Diagnosis.* Laceration of the cornea of the right eye; anterior endophthalmitis. Left eye, normal.

*Therapy.* Oral administration of sulfathiazole and intravenous injection of typhoid vaccine (3,500,000) together with atropine and adrenalin applied locally and subconjunctivally.

Five days after admission (April 4th) the hypopyon had cleared to a great ex-

tent, but the aqueous remained cloudy. No changes occurred in the thick plastic exudate. The pupil was slightly dilated, and there was hyperemia of the iris. There was now no light perception. X-ray studies showed no evidence of a foreign body.

On April 8th the pupil was contracted, the eye congested, and there was beginning vascularization of the cornea. The thick exudate remained unchanged. Light perception was present but light projection was absent except temporally. By April 12th, a large hypopyon had formed in the anterior chamber, filling nearly one half of the chamber. There was no light projection except temporally. The eye was greatly irritated; there was iris bombé, and iris tissue looked atrophic. Enucleation was planned. Chemotherapy had been continued until this time.

On April 14th, a saturated solution of sulfanilamide (0.8 percent) was injected into the anterior chamber, following the removal of about 0.2 c.c. of aqueous. The cloudy aqueous was examined bacteriologically but with negative results. The thick exudate did not move. After the injection the intraocular pressure was elevated, but there was no pain. Two days later the exudate was as before. The injection had been well tolerated. A second injection of sulfanilamide into the anterior chamber was made and an effort to puncture the vitreous in order to study it bacteriologically; but no vitreous could be obtained. It seemed to be of normal consistency.

On April 20th the eye was definitely better. There was less congestion, the aqueous was clearer, and the plastic

\* From the Eye Service of the Boston City Hospital.

exudate that had extended from the posterior surface of the cornea to the pupil had disappeared. There were no corneal precipitates in either eye. Iris bombé was becoming more marked, and several areas of iritic atrophy were observed. The pupil was contracted and fixed; there was no hypertension of the eye.

On April 28th there was less congestion and irritation. An iridectomy was performed.

May 2d. Following the iridectomy there was marked hemorrhage into the anterior chamber. The tension was normal. Five days later the hyphema had become absorbed; there was return of light perception. The eye was white, and quiet. Under slitlamp observation, no cells were seen in the anterior chamber.

On May 12th the condition of the eye was good, and the patient was discharged to the Out-Patient Department on May 16th.

The patient was admitted a second time to the hospital on August 17, 1942, and discharged on August 22d. The right eye was quiet. There was an old scar in the cornea, with anterior synechia. The iris was partly atrophied. Vision did not suffice to detect hand movements. There was good projection. Vision in the left eye was 20/30 with a -3.00D. sphere.

On August 18th a second iridectomy was performed, and there was no inflammatory reaction. Four days later a cataractous lens was visible.

On the patient's third admission to the hospital, January 11, 1943, it was decided to operate. On the following day a discission was made with deWecker scissors, and the small anterior synechia was freed. Convalescence was normal, and the patient was discharged on January 16, 1943.

On February 10, 1943, a clear hole was observed in the coloboma. With a correction of +12.00D. sph.  $\approx$  +3.00D. cyl. ax. 70° vision was 20/40.

## COMMENT

There seemed to be no question that the eye of this 12-year-old boy, who had received a perforating injury of the cornea by glass on March 28, 1942, was lost. The inflammation, the photophobia, the exudate in the anterior chamber increased daily, and there was only a slight light perception (even this was not sure). General treatment with sulfathiazole tablets, as well as with typhoid-vaccine injections, had apparently no beneficial effect. Enucleation was planned.

Could one expect anything from the local use of sulfa drugs? The usual method of local application in the eye (instillation, subconjunctival injection, powder in the cul-de-sac) was not promising in a case of purulent iridocyclitis. The only way to bring a high percentage of sulfanilamide to the diseased part of the eye seemed to be a direct injection of a saturated solution into the anterior chamber. V. C. Rambo<sup>1</sup> (1938) had shown in rabbits that there was no or only a very slight reaction even when a suspension of sulfanilamide powder in cold water (100 mg. to 1. c.c.) was brought into the anterior chamber. K. Heinz<sup>2</sup> (1938) found that prontosil was tolerated in the anterior chamber of rabbits without any irritation. Thus in such a lost case there was no risk in trying injections into the chamber, which I had performed many times with other drugs, especially in experimental work.

Whereas sulfanilamide is very soluble at high temperatures (47 gm. in 100 c.c. water or normal salt solution at 100° Celsius), the solubility is only 0.8 gm. percent at body temperature (Guyton,<sup>3</sup> 1941). This solution is probably the most suitable one for injection.

For those who are not familiar with anterior-chamber injections, the procedure may be briefly described: An empty 1-c.c. syringe, which is provided with a short, well-sharpened needle, is intro-

duced near the limbus. The end of the needle should always be between the iris and cornea and never in the pupillary area. Therefore it is advisable to put in the needle at about the 3-o'clock position with the direction toward 6 o'clock. When one is sure that the needle is free in the chamber, as much as possible of aqueous fluid is aspirated (generally 0.2 c.c.). Then, while the needle stays in the chamber, the fluid from the syringe is removed, the syringe is filled with the sulfanilamide solution, connected with the needle and 0.2 c.c. or a little more of this solution is injected. Syringe and needle should then be removed quickly. The finer the needle, the smaller will be the hole through which fluid can escape from the chamber.

The two injections were tolerated very well. The exudate shrank and disappeared. A few days after the second injection, irritation and inflammation of the eye decreased definitely. Ten days later an iridectomy could be performed because of the iris bombé. In the following months the eye was always quiet, but the coloboma narrowed, so that another iridectomy was performed in August, 1942,

and eventually a discission of the membranous cataract (in consequence of the perforating injury).

The vision improved more and more and was, at the last examination in February, 1943, 20/40!

From a critical point of view I assume that the inflammation (and infection) in our case was not very severe, because the puncture of the vitreous and the whole course showed that the inflammation was restricted to the anterior part of the eye. But clinically one did not know that and it was absolutely justified, even necessary, to plan an enucleation.

It may be that sodium sulfathiazole iontophoresis (Boyd,<sup>4</sup> 1942) is also very valuable in infections of the anterior globe.

#### SUMMARY

In a case of purulent iridocyclitis traumatica enucleation was planned because of great irritation and absence of light sensitivity. Following injection of sulfanilamide into the anterior chamber inflammation disappeared and final vision was 20/40.

636 Beacon Street.

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## A COMBINED PTOSIS OPERATION\*

ORWYN H. ELLIS, M.D.

*Los Angeles*

The operation presented for your consideration is a combined procedure for the correction of ptosis. The method is based chiefly on the Motais<sup>1</sup> operation—the utilization of a strip of the superior-rectus tendon, when that muscle has a normal action.

In the procedure, the skin is incised

in place. Through the opening in the conjunctiva the superior-rectus tendon is exposed. With the use of a muscle splitter, the tendon is divided into three equal parts, and is split as far back as possible. As much as half of the tendon of the superior-rectus muscle may be used without endangering its function.<sup>2</sup> A double,

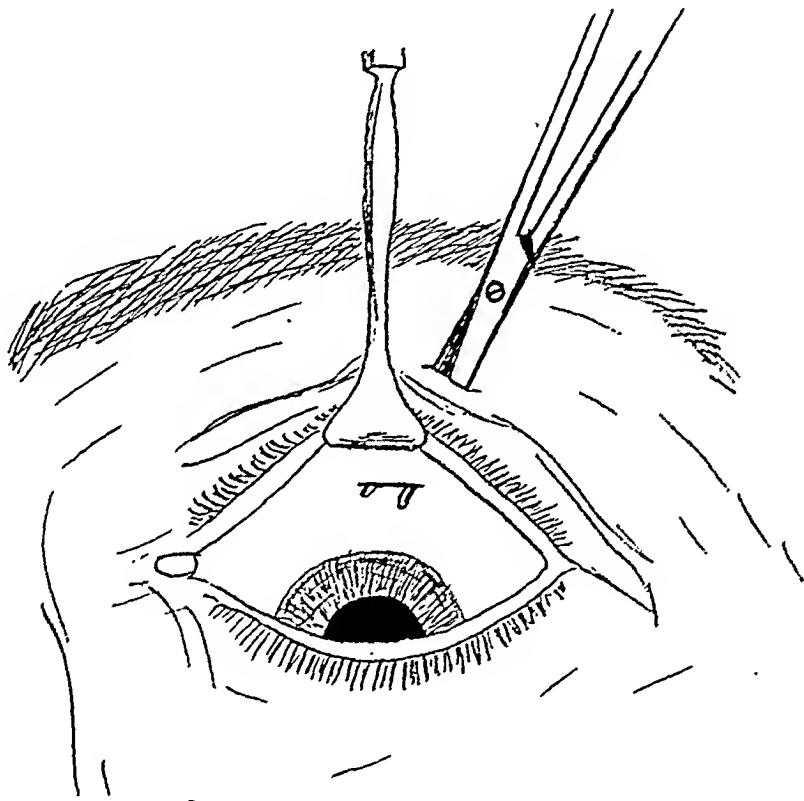


Fig. 1 (Ellis). Incision and blunt dissection.

with a scalpel at about the level of the upper border of the tarsus. Blunt scissors are introduced into the wound, and, by blunt dissection, the conjunctival surface is reached (fig. 1).

The upper lid is retracted, and the conjunctiva is opened over the superior-rectus tendon. A lid speculum is now put

double-armed black-silk suture (Deknatel "D") is now put into the middle section of the tendon; for this the Wiener cinch stitch is used (fig. 2).

The needle is introduced into the muscle tendon at about its middle, and two millimeters from the insertion. The needle is carried parallel to the line of insertion and within the tendon to the lateral border of the tendon strip. A whip stitch is

\* Read before the Pacific Coast Oto-Ophthalmological Society, May 13, 1942.

put in by introducing the same needle through the full thickness of the tendon just behind the previous suture and catching only a few lateral fibers. A similar stitch is put into the other half of the muscle tendon with the same suture. The middle third of the superior-rectus tendon is now shaved off the eyeball at its insertion with a scalpel. O'Connor<sup>3</sup> of San Francisco uses a double suture, splits

surface of the tarsus is cleaned almost to the free border of the lid. The four ends of the double suture are rethreaded separately, on small curved needles. These needles are passed into the skin opening and over the cleared tarsus. One from each side emerges through the skin just above the lashes and about five millimeters on each side of the midline. The next two are similarly placed except that they come

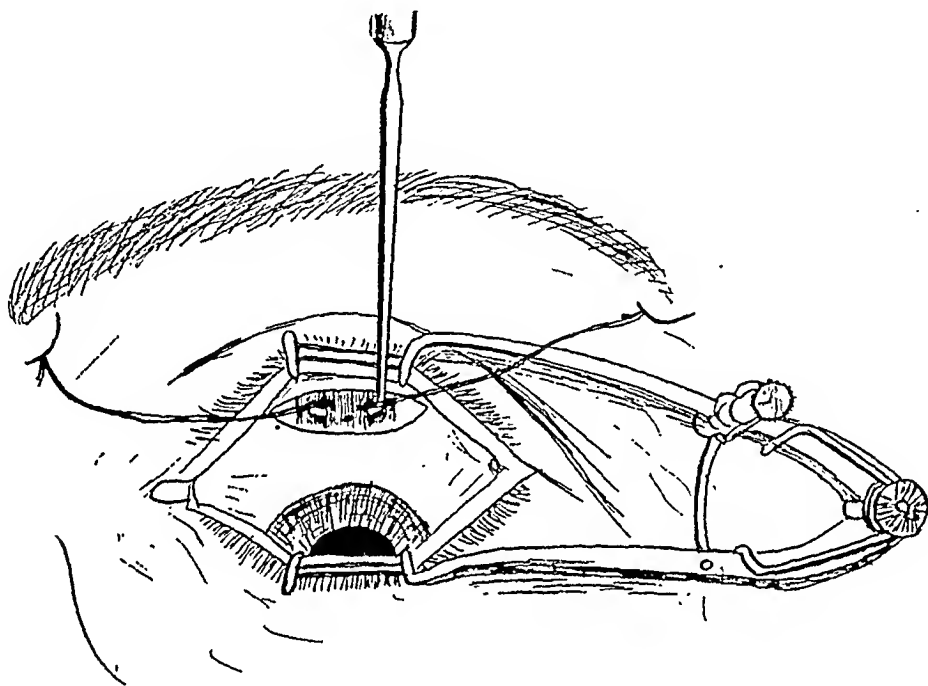


Fig. 2 (Ellis). Insertion of suture.

the tendon slip into three portions, and puts in his cinch stitch.

A narrow curved strip of metal, with two small holes in it, is introduced through the skin incision, and emerges in the opening in the conjunctiva. The sutures are passed through the holes in the metal strip, the lateral ones through the lateral hole and the medial ones through the medial hole, so that the tendon will not be rotated as it is pulled through (fig. 3).

The needles are cut off the sutures, and the sutures and the tendon are pulled through the metal strip to the skin opening. The skin edges are now retracted, and the central portion of the anterior

out one millimeter above the first pair (fig. 4).

These sutures are tied over a small piece of rubber, and the amount of correction desired is attained by adjusting the pull on the suture. This procedure, also taken from O'Connor's work, sutures the muscle in a flattened position, thus allowing a firmer and broader attachment, and therefore assuring a greater chance of success.

The skin incision is closed with interrupted black-silk sutures, and the conjunctiva with a continuous silk suture.

A Pagenstecher<sup>4</sup> stitch is put into the lateral and medial portions of the lid, derma suture being employed, with each

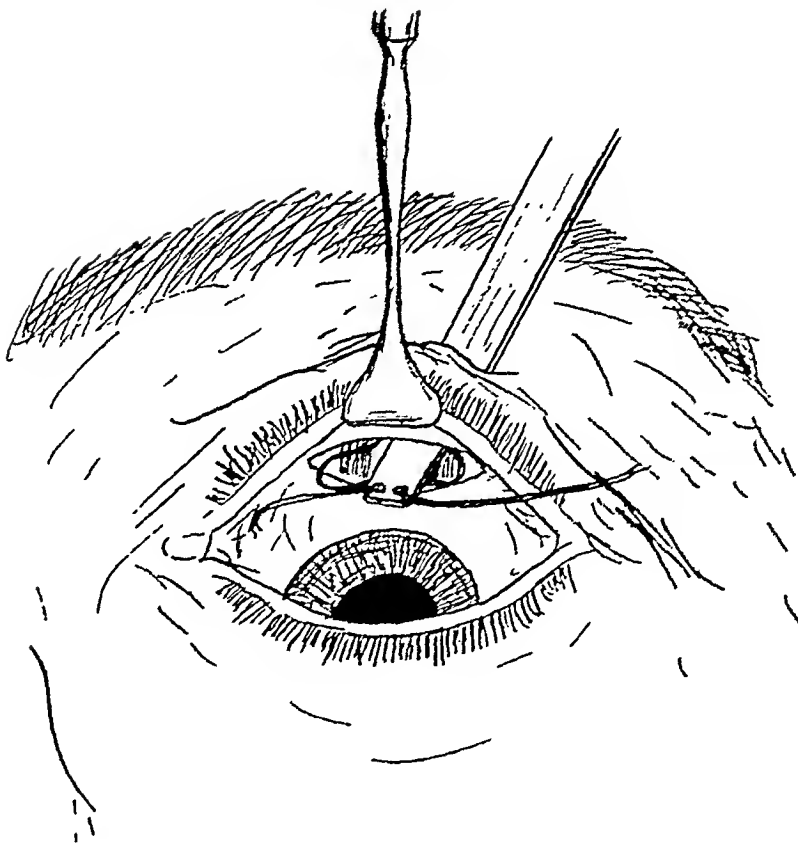


Fig. 3 (Ellis). Insertion of sutures through perforated metal strip.

end threaded on a large cutting needle (fig. 5).

The needle enters the skin laterally just above the lid margin, and is passed subcutaneously to emerge in the brow. The

course of the suture increasingly diverges from the midline. The other needle passes parallel to the first, and 3 to 4 mm. from it. The suture is passed through a small piece of rubber, and a friction knot is



Fig. 4 (Ellis). Sutures passed into skin opening.

tied. Another suture is similarly passed medially and tied over rubber. The eye may be closed by a Buller shield, or by pulling up the cheek and using an eye pad, as is preferred.

The practice of combining operations for ptosis is not new, and Wood<sup>5</sup> in 1911 suggested that the Motais operation might be combined with one of the deep-suture operations for supporting the lid. Such a procedure was reported by Webb

lowing the operations performed by the author.

In my opinion, not enough attention has been paid to the excellent modifications of the Motais operation by O'Connor, and many of the procedures contained in this paper are taken from his work.

#### SUMMARY

A combined operation for the correction of ptosis has been presented. This

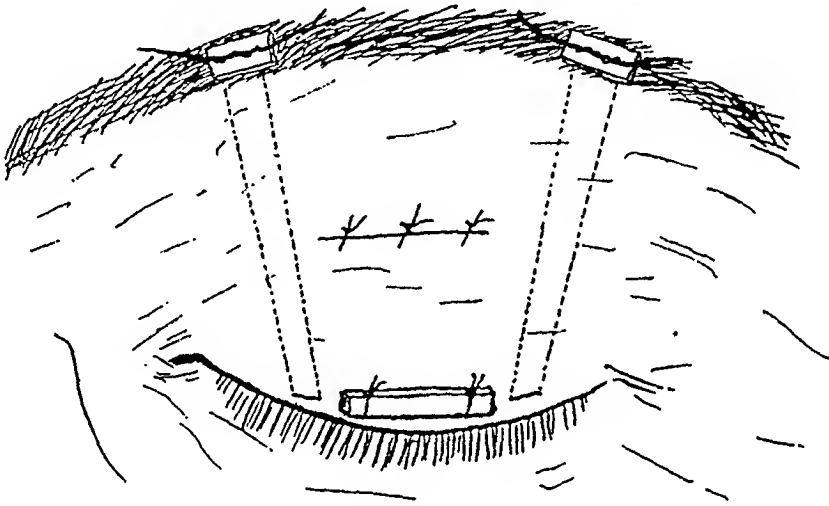


Fig. 5 (Ellis). Closure of incision, and placing of final sutures.

Weeks,<sup>6</sup> who combined it with a Motais operation and used a levator sling for the support of the superior-rectus muscle, after the method of Eversbusch.<sup>5</sup> In 1934 Frost<sup>7</sup> devised a supporting suture—a mattress stitch of both the upper and lower lids—to be used with a ptosis operation.

The use of the Pagenstecher suture in the procedure reported here accomplishes two purposes: (1) It acts as a traction or stay suture, allowing the strip of superior-rectus tendon to heal in the desired position without tension. (2) It assists in the elevation of the lid, and thereby lessens the strain on the superior-rectus muscle. At the same time it aids in avoiding the central peaked effect often following this type of operation. This undesirable result has not been present fol-

lowing the operations performed by the author. The procedure is based on firm surgical principles, and is indicated in cases of ptosis with good action of the superior-rectus muscle. In the literature the Motais procedure is the operation generally preferred, but no operation is applicable to all cases. The Motais operation is not technically difficult, and the additional procedure—the placement of the Pagenstecher sutures—does not lengthen the time of operation by more than a few minutes. Utilization of this procedure has brought gratifying results, and the operation is more likely to be successful than are most of the others, which also are harder to perform. 727 West Seventh Street.

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## DISCUSSION

DR. WILFORD H. BELKNAP (Portland, Oregon): I should like to compliment Dr. Ellis for presenting such an interesting paper; this modification of the Motais operation simplifies the procedure and it seems to me improves the operation. Ptosis is quite a problem. It is a deformity definitely disfiguring and should be corrected as early as possible.

Drooping of the lids or ptosis is either congenital or acquired; when a congenital malformation, it is due to improper development of the levator palpebrae muscle, or possibly the muscle is entirely absent. Acquired ptosis is due to paralysis or paresis of this muscle.

Cases requiring surgical intervention are usually congenital and also bilateral.

The muscles actively involved in elevation of the lids are three; in the order of their importance, the levator palpebrae, the frontalis, and superior rectus.

The levator, due to its insertion, draws on all structures of the lid at the same time and it is therefore the perfect elevator. The frontalis is less direct; its contraction raises the eyebrow, skin of the region is made tense, and in this way indirectly assists in opening the lid; very imperfectly to be sure. The superior rectus has even less direct action than the frontalis, its function as an elevator is due solely to a fascial band running from the superior rectus to the levator. Dr. Ellis uses the

middle portion of the superior-rectus tendon.

A few years ago, about 1936, Dr. C. Allen Dickey of San Francisco presented a paper before this Society describing his operation for ptosis. Dr. Dickey uses a fascia sling and utilizes the entire tendon of the superior rectus.

Dr. Trainor of Los Angeles has also described his operation, which consists of passing a portion of the tarsus underneath the entire tendon of the superior rectus: this is a very simple operation.

We must not lose sight of the fact that when we utilize the superior rectus in any operation of the lid, we bring about a mechanical connection between the eyeball and the lid which does not physiologically exist, and for this reason it seems to me that if the condition can be relieved by an operation on the lid only, such as the Blaskovics operation, this is probably a better procedure.

DR. FREDERICK C. CORDES (San Francisco): First of all, I want to congratulate Dr. Ellis. I think his movie is by far the best method of showing any new surgical procedure. There is no confusion at all and every step can be followed carefully and accurately.

As Dr. Belknap has pointed out, there is no one operation that applies in every case of ptosis and each case must be studied very carefully. Dr. Ellis's opera-



tion is primarily a modification of the Motaïs operation. Motaïs uses the central third of the superior rectus to pull up the lid; as Dr. Ellis pointed out, this causes tenting of the upper lid and with the modification he has made, I am sure that to a great extent it does away with this objection.

We have been using Dr. Dickey's operation at the University of California since he originally devised it, and we prefer it for several reasons: first of all, it is not difficult to do; second, you do not detach the muscle or any portion of it and, rather than rely upon a central third to do all the work, the latter is distributed over the entire muscle and, consequently, it would seem there should be less danger of fatigue.

Also, there is the advantage of being able to adjust it to any given position because of the fact that you use this sling behind the muscle. In addition, in those cases where an eye has been operated on and there has been a failure, it can be used without difficulty. One patient on whom I operated had had complete closure of the lid and had been operated on twice unsuccessfully. With this operation we were able to correct the defect.

We must keep in mind, however, that from any operative procedure to replace the function of a paralyzed muscle, we must not expect a perfect physiological result; there is no such thing as a perfect substitute for a paralyzed muscle.

In closing, I feel that Dr. Ellis's operation does away with some of the objections which have been made to the Motaïs operation.

DR. ELLIS. I wish to thank the discussers, Dr. Belknap and Dr. Cordes. In reply to Dr. Dickey's question, I operated on one boy three-and-a-half years old. First I did, as I have been doing, this Motaïs operation without the use of the additional Pagenstecher suture; this corrected the ptosis by about half. I then operated on the other eye with this combined procedure and it was successful. The first eye needed about 1.5 to 2 mm., and the superior-rectus tendon was isolated and tucked. That pulled it up also about half way. The Blaskovics operation was then used and a full correction was obtained. The operations that I have performed using the combined procedure have been successful and no repetition has been necessary thus far—the superior-rectus tendon has never slipped.

# PROCEDURES AND APPLIANCES THAT ARE HELPFUL IN TREATING INDUSTRIAL OCULAR INJURIES\*

WILLIAM B. CLARK, M.D.  
*New Orleans*

The following methods and appliances have been used by me for several years in treating industrial ocular injuries. Some are not original with me, others are.

1. *The Mueller shields.* The original Mueller shields were made of porcelain, and the first set that I saw was purchased

of curvature slightly less than that of the eyeball. The advantages in the treatment of burns of the eye with these shields are:

1. They separate the bulbar and palpebral conjunctiva and prevent the formation of adhesions of symblepharon.
2. They protect the damaged cornea from the conjunctival surface of the lids, which is also usually damaged in chemical burns of the eye.
3. They not only prevent, but, in my experience, have corrected cicatricial ectropia that have followed burns of the lids.

Mueller shields are used in the following manner. As soon as the burned patient comes under observation, the eyes are anesthetized with pontocaine, and the conjunctival sac and the cornea are thoroughly cleansed. Then the concave portion of the shield is filled with ophthalmic ointments, usually a mixture of holocain and adrenalin and atropine ointment, or scopolamine ointment, as the individual case may demand. The shield is then inserted in the same manner as an artificial eye is placed in a socket. The eye can then be irrigated at any desired interval, with normal saline solution or the solution of choice, without removal of the shield. This is done by placing a dropper filled with the solution over one of the holes in the shield, and with gentle pressure forcing it through the shield. As the solution comes out through the other holes and around the edges of the shield, the mucus and debris are washed out. If more ointment is needed it can be applied by inserting the tip of an ophthalmic tube into one of the small holes in the shield which is small enough to prevent the tip of the tube from coming in contact with the cornea as the ointment is forced in behind the shield. The shields should be removed

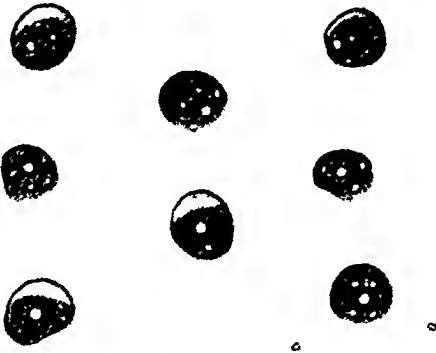


Fig. 1 (Clark). Eye shields.

in Vienna, in 1928, by Dr. Henry Blum, of New Orleans. As far as I have been able to ascertain, no reference to their use has been made in recent ophthalmologic literature, and since I have found them to be so helpful in the treatment of burns of the eye, both chemical and thermal, I feel that their use should be more widespread.

The shields that are demonstrated herein are made from a plastic and are obtainable from a firm in Chicago that makes artificial eyes. They are so constructed that when inserted in the eye they rest upon the bulbar conjunctiva in the upper and lower fornix, forming a shallow cone over the cornea. This is accomplished by having the shield's radius

\* From Department of Ophthalmology, Tulane University School of Medicine. Read before Birmingham, Alabama, Eye, Ear, Nose, and Throat Society, February 9, 1943.

and cleansed daily, then reinserted until the cornea is healed. In the case of eyes that have not been treated by this method in the early stages, symblepharon may already be present. A small shield is therefore inserted at first and its size gradually increased, at intervals of a few days so that the bands of adhesion in the upper and lower fornices can be stretched until their normal size is reestablished.

2. *Debridement of the corneal epithelium in superficial abrasions of the cornea that do not heal within 24 hours.* Many ophthalmologists have been impressed by the fact that the corneal epithelium may be abraded from most of the corneal surface one day and find it entirely reepithelized the next. The upper lids of a few individuals are so constructed that they seem to form a suction between the globe and the lid. If the cornea of such an individual receives an abrasion it fails to heal normally, so that for several days the abrasion remains at its original size, causing intense pain and secondary iritis. I have found that if these eyes are studied with the corneal microscope the epithelium surrounding the abrasion will be observed to be loose and to have very much the appearance of a ruptured blister, or bullus, as in bullous keratitis. If let alone this type of injury heals slowly, the eye sometimes requiring weeks to recover. It is frequently complicated by infection and secondary corneal ulcers. Such corneal abrasions may follow the removal of a foreign body; accidental trauma of the cornea, such as a scratch with the corner of a piece of paper, a leaf or twig from a flower or plant; or may be the result of the scratch of the eye with a baby's small but sharp fingernails. Most of the cases of this type are seen 24 hours or longer after injury. When an abrasion has not healed after this length of time I have found the following treatment most successful.

First the eye is anesthetized thoroughly by five instillations of a 1-percent solution of pontocaine at five-minute intervals; then a 1:1,000 adrenalin solution is instilled with the last two drops of the anesthetic. Using a speculum to hold the lids apart, I roll back the loose corneal epithelium from the abrasion with a tightly wound cotton applicator. At times it is surprising to observe how much of the corneal epithelium has been loosened by the suction of the lid. In many cases there will remain only a small rim of normal epithelium around the limbus, but there is no need to stop the debridement until all the loose epithelium has been removed; it will not reattach itself to Bowman's membrane. Following this the edge of the epithelium is cauterized with phenol or with a 50-percent solution of trichloroacetic acid, applied with a pointed applicator. If the original abraded area of the cornea appears to be infiltrated or infected, this area is also cauterized with the acid. The speculum is removed and 1-percent atropine ointment and 5-percent sulfathiazole ointment are instilled into the eye. Then the upper lid is elevated by grasping the lashes between the forefinger and thumb and brought down over the cornea. Both eyes are tightly bandaged and the patient is put to bed. The pain is controlled by opiates, and the patient's anxiety and fear, which accompany the bandaging of both eyes, may be controlled by using phenobarbital or bromides. Since it is difficult to have a patient cared for at home with both eyes bandaged, I prefer to treat this type of case in the hospital.

A few words about bandaged eyes. I have come to the conclusion that a bandage applied to an eye (whether, over one or both eyes) that does not hold the upper lid firmly in place so that the patient cannot blink the eye under the bandage, is useless; in fact, it is worse than no bandage at all. A loose bandage that

allows the patient to blink his eye beneath it only increases the irritation of the cornea because the lid is held more firmly than normal against it by the bandage as he blinks.

3. *A simple method that helps distinguish between acute congestive glaucoma and acute secondary glaucoma.* Probably few of us have not had patients who complained of a red and painful eye, follow-

the end of that time, this procedure is of no use.

I have found that to be able to distinguish between the two types of glaucoma is of great value, for the treatment of the two is entirely different. Acute congestive glaucoma is treated with miotics, and acute secondary glaucoma due to uveitis is treated with atropine and dionin and foreign-protein therapy.

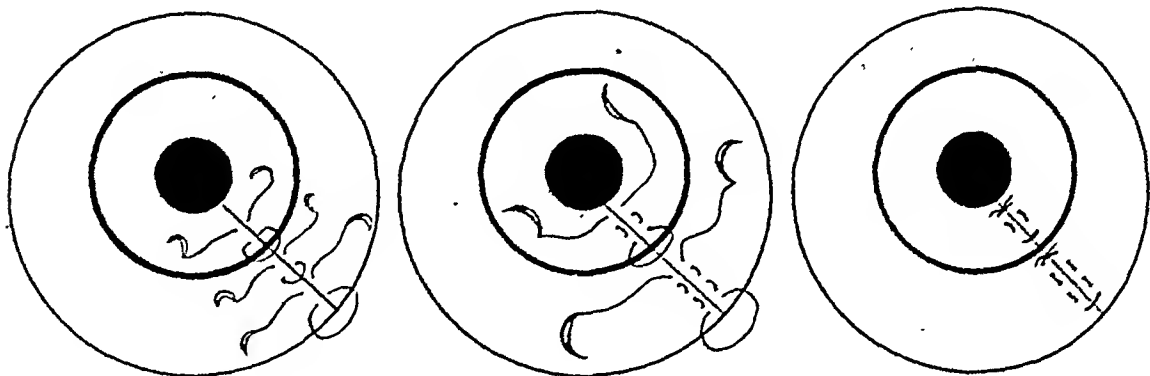


Fig. 2 (Clark). Sutures for corneal and scleral wounds.

ing a trivial injury, and who on examination were found to have an eye with markedly increased tension and a cornea so steamy that it was impossible to get a beam of the slitlamp to pass with sufficient intensity to make it possible to tell if there were secondary glaucoma or not. I have found that the use of 10-percent sodium-chloride solution, in the following manner, will in many cases clear up the corneal edema.

Since sodium chloride in 10-percent solution is quite painful when instilled into the conjunctival sac, the eye should first be anesthetized; then the instillations of the sodium-chloride solution are begun, two or three drops at five-minute intervals, for five or six times. The hypertonic saline solution will sufficiently draw the water from the edematous cornea so that the beam of the slitlamp will pass through the cornea and a differential diagnosis can be made. If the cornea has not cleared by

4. *A suture for closing corneal and scleral lacerations.* It is difficult to suture a lacerated wound of the cornea or sclera by placing interrupted sutures, for the sutures should not transfix the full thickness of the cornea or the sclera. If they do they leave an avenue for infection to enter the globe from without. But it is nearly impossible to place a suture into the lips of such a wound at the correct depth, for if the suture is put through one lip properly, then getting the suture through the opposing lip so that the wound's edges are approximated correctly is all but impossible. Frequently the pressure exerted in attempting such a closure means loss of vitreous, or more iris prolapse, or both.

This difficulty can be eliminated in part by placing corresponding sutures parallel to the wound on each side and tying the two ends across. This is accomplished in the following manner. A double-armed suture of 6-0 black silk on an atraumatic

needle is used. The suture is inserted first on one side of the wound and then on the other, always with the point of the needle in sight when suturing the sclera, so as not to perforate. The point of entrance and exit, and the line of the sutures, on each side of the wound should correspond in order to prevent gaping of the wound when the suture is tied. After the sutures have been inserted, the loose ends are drawn down and tied across the wound, not too tightly, but with just enough pres-

sure to approximate the edges of the wound. One or more sutures may be used, depending on the length of the laceration.

The sutures are left in place from 5 to 10 days, depending on the length and severity of the laceration, and they may be removed simply by cutting the untied end of the suture with sharp scissors or the point of a cataract knife, then grasping the knotted end with a fine pair of serrated forceps and pulling it out.

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## IMPROVED TECHNIQUE FOR IMPLANTATION OF A BALL IN TENON'S CAPSULE

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Over simple enucleation, implantation of a ball in the orbit provides two undisputed advantages of which no patient should be unnecessarily deprived. These are, prevention of unsightly sinking in of the upper lid, and increased range in the motion of the artificial eye. Mules,<sup>1</sup> in 1885, was the first to employ such a procedure. He enclosed a glass ball in the cavity left after evisceration of the eye. His operation yielded excellent cosmetic results, but since it retains the same objectionable features as simple evisceration, many operators, including myself, regard it and its subsequent modifications as unjustifiable. It is believed not only not to eliminate existing danger of sympathetic uveitis, but to introduce this danger when it does not already exist,<sup>2</sup> and it prevents microscopic examinations that might be of value to the patient and to science. Possibly some or all of the cases reported as sympathetic uveitis after Mules's operation were not really such, or would have occurred after com-

plete enucleation, but it is certain that more or less uveal tissue remains in the sclera after evisceration. The advantages of Mules's operation are not sufficient for me to be willing to expose a patient to even the slightest risk of sympathetic uveitis in order to gain them.

Enclosure of the ball in Tenon's capsule was proposed by Frost in 1886 (Middlemore Prize Essay). Lang<sup>3</sup> in 1887 reported the use of a similar procedure in 16 cases. He did not suture the muscles over the ball but united Tenon's capsule "horizontally by three fine silk sutures." In two cases he used catgut sutures, and these were the only cases in which the ball was extruded. He used a glass ball, but suggested that a celluloid ball might serve. In discussing Lang's paper, Frost stated that in only one of his own six cases was the operation completely successful. In one case the ball was retained but became displaced, and in four cases it became exposed and was removed. He attributed his poor results to

the facts that he sutured the muscles over the ball and employed catgut.

Instead of a glass ball, a gold ball, fat, bone, cartilage, and other substances have been used in Frost's operation. Fat is unsatisfactory because it always undergoes more or less absorption. I have found a glass ball so satisfactory that I have not experimented with other substances. Except for the cost, there seems to be no objection to a gold ball, and it obviates the remote danger of breakage. However, the glass ball has never broken in any of my own cases. It is still only an assumption that any of the other implants that have been recommended, including plastics, will stand the test of time as have glass and gold balls.

Perhaps unaware of Frost's poor results, and undeterred by their own, many operators have continued to suture the muscles over the ball in the belief that this procedure reduced the danger of extrusion and increased the mobility of the artificial eye. Observing many cases, and hearing of many others in which after this procedure the ball became displaced outside the muscle cone, I long ago concluded that the tightened muscles tended to force out the ball between them. Moreover, motion of the artificial eye is directly dependent not upon motion of the ball, but upon retraction of the conjunctival sulcus by the muscle that moves the ball. It seemed to me that this retraction would be greater if the muscles were not sutured over the ball, provided they did not slip too far back. I devised a new method of suturing Tenon's capsule, so as to provide a firm covering for the ball without suturing the muscles. Designated by my name, this method was published in 1919 by Howard.<sup>4</sup> Since then it has been routinely used by the staff of the Massachusetts Eye and Ear Infirmary. Periodically there are new internes here who try including the muscle tendons in

the single suture, but who, later, finding that this is disadvantageous, cease doing so. Apparently the method has not been commonly used elsewhere, no doubt because its advantages have not been widely emphasized.

For holding the ball in place, I used only one suture, not merely for the sake of simplicity, but because I believed it to be more effective and safer than multiple sutures. Wherever a suture is inserted it tends to cause necrosis and thus provide an exit for the ball. The tighter the suture and the less the amount of tissue it includes, the greater this tendency. Hence a single suture which includes a considerable amount of tissue and is not tied too tightly, is preferable to multiple sutures each of which includes only a small amount of tissue. Originally, owing to fear of infection from the catgut then available, I employed a silk suture which was carried through the conjunctiva, tied over a button, and subsequently removed. For some years now I have used, instead, a catgut suture (#000 chromic catgut) covered by the conjunctiva. This did away with the annoyance of removing the suture, and proved to be safe—the ball has not been extruded in any of my cases. I have also modified the operation in a few minor details, and have added a procedure that I believe to be of considerable value; namely, the introduction of a form into the conjunctival sac at the completion of the operation. A brief description of the operation as I now perform it follows:

The conjunctiva is severed close to the corneal limbus, and then, with all the underlying tissue down to the sclera, is carefully dissected from the globe—at this stage the conjunctiva is not dissected from Tenon's capsule. After the eye has been removed, the socket is kept packed with gauze until hemorrhage has practically ceased. Then the glass ball is in-

serted and pushed back into the orbit. With a broad fixation forceps, Tenon's capsule is grasped near the cut end of the external rectus tendon, and a tongue, consisting of two layers of the capsule, is pulled forward. About 5 mm. behind the end of this tongue the two needles of a doubly armed catgut suture are passed through the tongue from beneath, about 6 mm. vertically apart. The two needles are then passed from beneath through a similar tongue in front of the internal rectus tendon. Then they are passed from beneath through a tongue in front of the superior rectus muscle, not side by side, but one in front of the other, the upper about 7 mm., the other about 3 mm. back. The needles are then passed through a tongue in front of the inferior rectus tendon, the lower needle the farther back. The ends of the suture are now pulled upon until all four tongues are brought into a pile in front of the ball. The suture is then tied securely and cut close to the knot. The loop of suture should firmly, yet not severely, compress the tissue it encloses. If, as is exceptionally the case, the conjunctiva does not lie smoothly, or is under undue tension in places, it is now suitably dissected from the underlying Tenon's capsule. If, as is usual, the conjunctiva comes easily together, the conjunctival opening is horizontally closed by a continuous silk suture, and the catgut suture thus buried. Otherwise, interrupted sutures are used for uniting the conjunctiva. The conjunctival sac is filled with 5-percent sulphathiazol ointment, a form of suitable size placed within it, and a pressure bandage applied over the closed lids. The form should not be so large as to prevent easy closure of the lids.

The bandage and the form are removed at the end of three days, and the socket inspected. If the reaction is slight, as it usually is, and postoperative hemor-

rhage is not feared, a light bandage is applied to absorb the secretion, and the patient allowed to go home. If there is considerable chemosis, the form is reinserted, the pressure bandage re-applied, and both allowed to remain until the edema has considerably subsided. The conjunctival suture is removed at the end of a week.

As a rule the patient begins to wear an artificial eye two weeks after the operation. At first he is provided with a "stock eye" of approximately the correct size and color. About six weeks later, if he so desires, he has a prosthesis made especially for him. Generally, the eye maker wishes to make the final eye before the socket has become thoroughly established.

It is to be noted that the suture in Tenon's capsule does not act as a purse string. A purse-string suture leaves a weak spot in front of the anterior pole of the ball, just where the ball tends to become extruded. Moreover this is the place that must bear the brunt of the pressure of the artificial eye. The single suture inserted as I have described brings together in front of the ball four overlapping tongues consisting of eight closely applied layers of Tenon's capsule. The muscle tendons are pulled forward by the capsule so that their cut ends reach a point somewhat anterior to the equator of the ball.

As to the shape of the ball, I believe that it should be as nearly spherical as possible—an aspherical or grooved ball would be more likely to be extruded and would tend to undergo undesirable rotational displacement. As to the size of the ball, a compromise must be made between the mobility and the prominence of the artificial eye to be worn. Within certain limits the larger the ball the greater this mobility, but if the ball is too large a shell eye may be necessary and even this may be too prominent. The makers of

artificial eyes prefer the ball to be too small rather than too large. I am partly influenced, as to the size, by the tendency of the ball to come out before the suture is tied. For adults, I usually select a ball 18 mm. in diameter.

The purposes of placing a form in the conjunctival sac at the end of the operation are to press the conjunctiva into the proper position, and to combat the edema which otherwise might cause the conjunctiva to project between the lids. I have used this procedure for many years, and it is now in common use by the Infirmary staff. Until lately I have used reform artificial eyes, although these were not so suitable as could be desired. Those available to me, when otherwise sufficiently small, were too narrow horizontally to afford adequate protection against excessive edema at the inner and outer canthi. They were also too deeply concave. Recently I have carved out wooden forms which for the purpose at hand, have proved to be more suitable in size and shape. Sterilized in 95-percent alcohol and then coated with ointment I have found them to be nonirritating during the short time they remained in the sacs. Similar forms made of glass or plastic would, of course, be preferable.\*

Except in cases of children and in cases of severe infection I always employ local anesthesia for the operation. In my opinion, except in such cases, the risks of general anesthesia are unwarranted. Most operators inject the orbit through the conjunctiva. Years ago it occurred to me that it would be safe to employ local

anesthesia in cases of relatively mild intraocular infection, provided the needle was passed through the lids. I did this in such a case, and the result was so satisfactory that I have since almost invariably made the injections through the lids even in the absence of infection. Quickly passing the needle through the lid causes remarkably slight pain. I employ the usual solution—procaine 2 percent with epinephrine 1:50,000. Two cubic centimeters are injected deeply into the orbit through the upper lid near the inner canthus, and the same amount near the outer canthus. Then at the midline, 1 c.c. is deeply injected just below the upper orbital margin, and 1 c.c. just above the lower orbital margin. The last injection I have found to be very important, for without it dissection below the globe is always painful. In spite of the large amount of anesthetic injected, I have never seen it produce any serious systemic effects even when there was high blood pressure. This may be because the eye is so promptly removed that absorption is minimized. I use no preoperative medication, but prescribe codeine or morphine after the operation, if the patient then complains of pain.

In a few of my cases there was excessive postoperative edema, presumably due to hypersensitiveness to procaine. This, of course, prolonged the convalescence. In two of my cases there occurred, on about the third day after operation, intraorbital hemorrhage so forcible as greatly to distend the orbital tissue. Surprisingly enough, in neither case was the glass ball extruded. In the first case I removed the ball, but I now feel sure that this was unnecessary. In the other case the hemorrhage was more severe, causing the orbital tissue and edematous conjunctiva to protrude between the stretched eyelids like a large tumor mass. It also distended the lymphatics of the

\*I have had the wooden forms copied in plastic, in three sizes, by a dental technician, S. S. VanAtten, 363 Marlborough Street, Boston, Massachusetts. The plastic forms will not withstand sterilization in alcohol, but are not harmed by 10-percent formalin. Five minutes' immersion in 95-percent alcohol produced innumerable cracks in their surfaces. Owing to war conditions I have been unable to have the forms copied in glass.



face as far as the preauricular gland, and engorged with blood the conjunctival lymphatics of the other eye. Two and one-half months were required for the mass to shrink sufficiently to permit the wearing of an artificial eye, and seven months before the cosmetic result was finally satisfactory. The fact that neither excessive intraorbital edema nor hemorrhage caused extrusion of the ball in any of my cases, demonstrated the security of the method of suturing. In my opinion the hemorrhages occurred not on account of, but in spite of the ball implantations.

Except in cases of severe infection, I implant a glass ball after every enucleation, even including those for intraocular tumor. In cases of malignant melanoma of the choroid, ball implantation provides an additional advantage exemplified by the following case: The eye had been removed and a glass ball implanted by a colleague who had then sent the eye to me for microscopic examination. I found the eye about one-third filled with an unpigmented spindle-cell malignant melanoma which had perforated the sclera at one side of the optic nerve and had been cut through in the removal of the eye. I explained the conditions to the patient

and he refused evisceration of the orbit, but permitted an attempt to excise the remaining orbital growth. When I removed the ball two weeks after its implantation, it left a well-defined cavity at the bottom of which the region of the extraocular growth was easily determined by its relation to the optic nerve. Microscopic examination of the tissue which I excised from this region showed it completely to include a tumor mass similar to that in the eye, and 8 cm. in diameter. The socket was given X-ray treatment on the day of the operation and twice afterwards. When I last saw the patient, 15 years later, he was in good health, was wearing an artificial eye, and showed no local recurrence. Of course, in the case of a highly malignant tumor the risks of local recurrence and of metastases would be greater, yet no doubt most patients would prefer to submit to them rather than to undergo the horrible mutilation of an exenteration. In another case of the kind I should reimplant the glass ball, and omit X-ray treatment, for, from what is now known, it is certain that this treatment had nothing to do with the successful outcome.

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# NONSURGICAL ASPECT OF OCULAR WAR INJURIES\*

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The discussion of this subject is based on knowledge gained during the First World War, civil practice, and the reports from abroad based on experiences in Poland, Barcelona, Dunkirk, Coventry, London, and the front lines.

Shimkin,<sup>1</sup> who in the last war was an ophthalmic surgeon at the chief casualty clearing station on the Russian front, and who was later at a base hospital, states that in that war 2.25 percent of all wounded sustained ocular injuries. Loewenstein,<sup>2</sup> from knowledge based on front-line experiences in the present war, found that 12 percent of all injuries were to the eye. With increased naval warfare and the possible use of gas the percentage is expected to rise to 15-17. This is a high value when one remembers that the eye comprises only 1/300 of the body surface. Often the ocular injury is only one of many and is at first overlooked.

There are certain basic causative agents that produce eye injuries in warfare.

(1) *Artillery fire.* This, according to Loewenstein,<sup>2</sup> is one of the most important causes of ocular wounds, especially when the surroundings are stone buildings, cement, or like materials.

(2) *High-explosive bombs.* Ballantyne,<sup>3</sup> as a result of his experiences in English air raids and 250 Barcelona air raids, found that these bombs were the most common cause of eye injury. High-explosive bombs when falling in cities devastate wide areas and scatter rock, sand, brick, concrete, glass, and other materials in all directions. These particles may enter the eye.

(3) *Incendiaries.* These are not apt to

be dangerous unless water is thrown on them, when they scatter burning fragments.

(4) *Flame burns,* as seen in oven, furnace, or gasoline explosions, may cause scorching.

(5) *Contact burns* may occur from molten metal, burning wood, and the like.

(6) *War-gas burns.* These are caused chiefly by the vesicant gases, such as mustard or Lewisite.

Certain basic principles underlie the treatment of ocular war injuries. Exclusive of gas injuries, Loewenstein,<sup>2</sup> Ballantyne,<sup>3</sup> and Tyrrell<sup>4</sup> have all advised against too much interference, especially early. Tyrrell, in the London bombings, because of the scattered casualties, often had to let ocular injuries alone for 24 hours. He found to his surprise that he often got better results in these cases than in those that received immediate attention. As a result of this experience he began deliberately to let some of his cases alone for 24 or more hours. Patients who have perforating eye injuries often exhibit considerable shock and restlessness. If treated for shock and allowed to recover from it before the eye was treated, the patient often stood operation and repair of the eye much better.

People exposed to effects of demolition bombs are indescribably dirty. The dirt seems to have been blown right into the skin and the conjunctival sacs are filled with "mud." In these instances it is wise to irrigate the conjunctival sac gently a number of times at hourly intervals with very mild antiseptics before surgery or repair is attempted. The only urgent operation is excision of prolapsed irides and coverage of wound with a flap.

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## TREATMENT OF EYE INJURIES

Lid injuries, conjunctival tears, corneal wounds, various types of penetrating injuries of the globe, prolapsed irides, are all surgical problems that require immediate care. This phase of the subject has recently been discussed by Hartmann.<sup>5</sup> I would like to emphasize one point, however; namely, the necessity of careful detailed repair of lid wounds to prevent notching and to protect the eye. If proper facilities are not available repair should not be attempted. Meyer Wiener<sup>6</sup> recommends that if facilities are not available the wound be cleaned up gently and moist compresses be applied over the eye, and that the patient be sent to the base hospital where proper repair can be made. The importance of gentle care in the handling of injuries bears emphasis. Rough treatment may do a great deal of permanent damage.

## FOREIGN BODIES

(1) *Cornea*. When searching for foreign bodies one should not neglect to evert the upper lid, as large foreign bodies may be lodged there. A lash caught in the punctum also may cause a great many symptoms and may be overlooked.

In the removal of a *single foreign body* the case is handled as in civil practice. The importance of the aftercare should be kept in mind and the case followed until the cornea has healed. In cases where there is a circle of rust that cannot be removed easily it is well to keep the eye bandaged for 24 hours, at the end of which time enough infiltrate will have formed around the foreign body to facilitate its removal. The use of a dental burr often aids greatly in this procedure. If a foreign body spud is not available, the suggestion made by Harding<sup>7</sup> will be useful. He found that a regular stainless-steel hypodermic needle, 25 gauge, was a good substitute for a spud when mounted on a

small, hollow, chrome-plated brass handle. In the absence of this handle the barrel of a tuberculin syringe will do nicely.

*Multiple foreign bodies* are frequently encountered and consist mostly of stone, sand, metal, and so forth, from bombs and artillery blasts. Do not try to remove all of them at once, but lavage and clean out the conjunctival sac, bandage the eye, and wait 24 to 48 hours. From experience in tattooing a cornea with India ink it is known that this tissue has a tendency to extrude minute foreign bodies. Thus we find at the end of 24 to 48 hours that many of the small foreign bodies have been extruded. In addition the corneal epithelium has had time to regenerate, and thus lessen the risk. The remaining foreign bodies can now be removed, a few at a time, under favorable circumstances. In some instances inert foreign bodies may be so deeply imbedded that their removal would do more damage and cause more interference with vision than if they were let alone. Limestone causes a good deal of irritation and therefore must be removed even though there are multiple foreign bodies.

(2) *Intraocular foreign bodies*. In the consideration of intraocular foreign bodies it is well to remember that they may be bilateral. One eye may be rather severely damaged and suggest the presence of an intraocular foreign body while the fellow eye appears to be normal. Often the point of entry is so small as to escape detection and yet the end result to vision may be most destructive and all out of proportion to the minute size of the foreign body. For this reason detailed examination of the fundus and X-ray study are indicated for the apparently well eye whenever there is a possibility of injury by multiple foreign bodies.

According to Loewenstein 90 percent of the intraocular foreign bodies in civil

practice are magnetic, while in war 90 percent of the foreign bodies are non-metallic and consist principally of sand, stone, debris, and glass. The metallic foreign bodies are from hand grenades, large shells, and other explosives. Among this group there are many nonmagnetic foreign bodies, consisting of copper, copper with nickel alloy, aluminum, and lead. It is interesting that at one of the larger naval hospitals on the Pacific Coast up to January 1, 1943, there had been no cases of magnetic foreign body in the casualties returning from the South Pacific, although there were many ocular casualties.

The last war changed our ideas regarding the tolerance of intraocular foreign bodies. The tolerance is good to rock, concrete, aluminum, and lead. In addition, spontaneous extrusion of intraocular foreign bodies has been reported a number of times since Castelnau<sup>8</sup> first described this phenomenon in 1842. It apparently occurs far more frequently in the case of copper than of iron or other foreign bodies. Instances have been reported in which copper and other particles have remained in an eye for a long period of time. Often these become encapsulated and may cause no trouble for many years. Such a case came under my personal observation<sup>9</sup>—a piece of copper fragment from a percussion cap has been retained in the globe over a period of 46 years.

*Copper* and its alloys are nonmagnetic, and removal or attempted removal may cause more damage than the presence of the metal itself. Most of the copper foreign bodies seen are alloys with a relatively low percentage of copper. They may be well tolerated. At times they may be extruded along the path of entry. If the foreign body is not too large it may become absorbed with the formation of chalcosis.

*Chalcosis of the lens*, so-called copper cataract, was not recognized as a separate entity until World War I. According to Jess<sup>10</sup> there is a definite reason for its discovery as an entity at a comparatively recent date. During the first World War, because of the scarcity of copper, the various explosive shells were made of metal containing a relatively small percentage of copper. Consequently, if a particle of this metal entered the eye, the violent reaction produced by pure copper was not present; instead there was a slow oxidation of the copper with the production of chalcosis.

The characteristic picture of chalcosis, as a rule, begins to appear several years after the introduction of the foreign body. There is present on the lens a disciform opacity occupying the pupillary area. It is greenish gray in color and rather metallic in appearance. In marked cases, the color may be a definite green. The edges of the ring are often serrated, with lines radiating to the periphery of the lens. Under oblique illumination, the opacity appears rather dense, but, as a rule, little difficulty is experienced in seeing through it with the ophthalmoscope.

Under the higher power of the slit-lamp, this disciform cataract is seen to be composed of multiple minute particles that appear to be just below the capsule of the lens. There is also some discoloration of the iris.

Microscopic examination shows this opacity, which has been identified as copper carbonate, to be situated beneath the anterior capsule of the lens and the epithelial cells. In the more marked cases, this copper carbonate is found in the deeper layers of the lens.

The prognosis in these eyes seems to be fairly good. If the copper particle is small it may gradually become entirely absorbed. After the absorption or removal of the foreign body the chalcosis may

slowly disappear. In one bilateral case personally observed<sup>11</sup> a traumatic cataract developed in one eye and the typical picture of chalcosis in the other. Six years after the injury there was no X-ray evidence of a foreign body in either eye, and eight years after the injury the picture of chalcosis had almost entirely disappeared and the vision of the eye was 20/30 with correction.

*Iron and steel.* That there is spontaneous absorption of intraocular foreign bodies of iron is well known. The picture of siderosis is so familiar that description is unnecessary. Many such cases, in which there were disastrous results to the eye, are to be found in the literature.

This emphasizes the necessity of removal of iron or steel. The importance of X-ray examination cannot be overemphasized. The history, X-ray, and "magnet pull" all help to diagnose the presence of a magnetic foreign body. Their removal by the magnet is well understood. Recently several writers have stressed that in war surgery the foreign bodies should be removed only under favorable circumstances. If these do not exist it is much wiser to delay the attempted removal until the proper facilities are available.

*Glass* is well tolerated, as a rule, if the foreign body is in a position where there is no movement. It is important that all particles of glass in the conjunctiva and cornea be removed. Because of the difficulty of seeing these particles good magnification and adequate oblique illumination are essential. In civilian war injuries glass foreign bodies have been rather common, due to windows being blown in and broken. In the majority of glass injuries the eye is so severely damaged that little can be done.

Foreign bodies may be well tolerated

in the lens if the entry has been through the iris, as in this instance the iris may very quickly become adherent to the capsule wound and thus prevent the formation of a traumatic cataract. One case has been observed for 10 years in which there was a small splinter of wood in the lens without the development of a cataract beyond a small amount of opacification immediately surrounding the foreign body.

### CONTUSIONS

Contusion of the eyeball with its resultant rupture of the choroid, retinal hemorrhage, and detachment, was one of the commonest causes of blindness in World War I. According to Tyrrell and Loewenstein contusions to the eyes are common and very destructive in the present war.

*Contusions from without* cause the symptoms and changes that are so well known in civil practice. In the anterior chamber there may occur hemorrhage from the rupture of Schlemm's canal or from the iris; there may be iris tears and the well-known changes in the pupil, which may be permanent or may disappear after six to eight weeks. The lens may show a Vossius ring, rosette opacity, rupture, or luxation. In the retina, rupture of the choroid and retinal hemorrhages with detachment form the typical findings. Berlin's edema and hole in the macula are also noted at times. In a certain small percentage of cases delayed intraocular hemorrhage may occur three to five days after the injury.<sup>12</sup> The care of such cases of contusion is the same as that used in civil practice. The delayed intraocular (vitreous) hemorrhages, if extensive, clear slowly, at times requiring a year. On the whole, if the eye was apparently normal in the interim between the contusion and the delayed hemorrhage the ultimate prognosis for vision is good.

*Orbital contusion.* This usually results from missiles passing into or through the orbits above the level of the zygoma. Rifle and machine-gun bullets in their passage through the orbits destroy the bony frame. The enormous kinetic energy developed by these bullets and by the bone spicules, together with concussion waves imparted to the orbital contents, results in severe damage. In addition to the lesions noted under contusions from without, evulsion of the optic nerve occurs in orbital contusions. In this condition the optic nerve and the lamina cribrosa are torn from the scleral hole. Ophthalmoscopically the condition is recognized by the absence of the disc and vessels. Many cases are missed because of intraocular hemorrhage. In 50 percent of the cases the injury is caused by a thin, rod-like foreign body entering the orbit alongside the globe, or by temporal gunshot wounds. In addition to the nerve injury there are usually extensive chorioretinal changes.

#### ORBITAL INJURIES

As has already been stated, the explosive action of rifle and machine-gun bullets in wounds of the orbit is very destructive. All orbital injuries above the level of the zygoma should be considered as brain cases until proved otherwise, for the explosive effect of bullets on the bony walls of the orbit often causes rupture of the roof of the orbit. Do not explore the orbit too radically if at all—it may result in considerable damage. Many retained foreign bodies of the orbit are extruded. As Wiener<sup>6</sup> pointed out, emphysema and crepitation in the skin around the eye and in the lid mean fracture of the bony wall of the orbit with air from the nose infiltrating into the tissues. The fracture may not be visible by X ray.

The *optic nerve* may receive direct in-

juries. Bone fragments, tipped clinoids, and hemorrhage into the sheath may injure the optic nerve. In addition to evulsion of the optic nerve, oblique injuries may sever the nerve behind the optic disc, with resultant primary optic atrophy accompanied by extensive chorioretinal changes. These cases are seen in civil practice as a result of temporal gunshot wounds in attempted suicide. They have also been reported as war injuries.

*Windage*, or remote effect of explosive bombs together with sudden atmospheric expansion, may cause some queer and rather severe ocular injuries; such as, proptosis, rupture of the eyeball, and rupture of the choroid.

*Sympathetic ophthalmia.* The incidence of sympathetic ophthalmia in the last war, according to Greenwood,<sup>12</sup> was extremely low. The fear of sympathetic ophthalmia is exaggerated. It does not occur until seven or more days after injury, so that there is ample time to get the patient to a base hospital. The offending eye should not be enucleated indiscriminately should sympathetic ophthalmia develop, for at times the offending eye retains the better vision once the process has subsided.

#### BURNS OF THE EYELIDS AND GLOBE

*Burns of the eyelids* have recently been discussed in detail by Hartmann.<sup>5</sup> It is recognized that tannic acid should not be applied to the eyelids and face. The burned area should be gently cleansed with warm saline solution and the surrounding area with soap. Blisters should be opened and loose epidermis removed. After this a dressing is applied that will keep the burned area clean and that upon removal will not be damaging to the new epithelium. Hartmann advocated painting the burned surface several times with a

2-percent aqueous solution of mercuriochrome.

*Cornical burns* may be caused by a number of agents, but are rare, for it is difficult to burn the cornea; usually only the epithelium is seared.

Incendiaries are not apt to be dangerous unless water is thrown on them, when they scatter burning fragments and may cause severe contact burns of the cornea.

Flame burns with scorching are the most common type of burn about the eyes, and are due to oven, furnace, or gasoline explosion. It should also be kept in mind that during the burning of a building gases may accumulate in the ceiling which explode when they come in contact with a gust of outside air. These burns at times may be very severe. The appearance of these scorching burns is usually serious; the cornea appears white, there is loss of vision, the lids are swollen. As a rule, however, the only damage to the cornea is a searing of the corneal epithelium which regenerates in 24 to 48 hours.

Contact burns with molten metal, wood, and so forth, are more-serious, but even these usually appear to be worse than they really are.

The treatment of these burns is similar to that used in civil life. One point however does bear emphasis; namely, the avoidance of the routine application of anesthetics to the eye. These impair the epithelial regeneration and thus may not only delay healing but may also even encourage the formation of ulcers. After the eye has been carefully examined, for which anesthesia may be necessary, pain, if it persists, should be controlled by oral or hypodermic administration.

#### WAR GAS INJURIES

It has been stated that gas has not been used in this present war. In San Fran-

cisco, draft-board examination of Chinese who have been in the Chinese Army has given unmistakable evidence of its use in China by the Japanese. Most of our knowledge, however, is based on war experiences in the last World War and on animal experimentation. While gas may not be used, both sides are prepared for its employment, and if the situation becomes too desperate the enemy may again resort to its use. Therefore it is important that the effect and treatment of war gases be known.

In order to understand the basis of various suggested treatments it is essential to understand the pharmacologic basis of their action. This has been described by Leake and Marsh.<sup>14</sup> If gases are used they will probably be mixed; it therefore seems unwise to worry about specific identification and specific management of potential injury, if such identification is based on so indefinite a criterion as the odor.

Absorption of ordinary war gases and their many obvious chemical relatives may be inhibited by oxidation, neutralizing hydrolysis, or adsorption. For civilian use these methods may be applied from materials found in the average home. Since the war gases in general are decomposed and poorly soluble in water a wet cloth tied over the nose and mouth is a relatively effective barrier to the passage of such vapors to the nose, throat, and lungs.

The most readily available oxidizing agents are the common kitchen bleaching agents such as "Clorox", "Purex", "Sani-Clor", and the like. These are buffered 3- to 5-percent solutions of sodium hypochlorite and are non-irritating for blotting the skin, but should be diluted for application to the mucous membranes, for washing the skin, or for wetting cloths to breathe through. It has been shown conclusively that these solutions are ef-



fective in converting both mustard gas and Lewisite into nontoxic residues.

For alkaline hydrolysis, a 2-percent sodium bicarbonate solution is advocated. It can be easily prepared even in a blacked-out room, by dissolving a teaspoonful of baking soda in a glass of water. This solution is to be used in washing out the eyes, nose, and throat, and for wetting cloths to breathe through.

The most effective and easily available detergent adsorbent is lather from ordinary soap and water or soap flakes. This is particularly useful in preventing skin injury from suspected contact with the vesicant gases. The hands, the face, and especially the skin around the eyes should be thoroughly washed by this method.

The common vesicant gases are soluble in kerosene, gasoline, acetone, carbon tetrachloride, and similar fat solvents. It was thought the use of these agents would be useful. Marsh and Leake,<sup>15</sup> however, have shown that even under controlled conditions they are much less satisfactory than lather or hypochlorite.

Several different types of gas have been used and a more detailed account of each seems advisable.

*Tear gas.* The vapor of lacrimator gases is unimportant except for its nuisance value. On rare occasions if the liquid gets into the eye—as, for example, with the accidental discharge of tear-gas guns at close range—the action is more corrosive and resembles an acid burn. The chemosis in these cases at times becomes so marked that canthotomy is indicated.

Where some of the solution has caused a reaction the instillation of the following solution is advocated:

Sodium sulfate	0.4 gm.
Glycerine	75.0 c.c.
Water	100.0 c.c.

If this solution is not available then copious lavage with water is indicated.

Most cases of burns of the eye were from the vesicant gases. These may act like ammonia in that there is an immediate severe burn with great pain, followed by a period of healing when the eye appears to be returned to normal, and then gradual deterioration. This, however, is only in the severe cases. There are two principal vesicant gases: mustard and Lewisite. Of them mustard gas is the more important.

*Mustard gas.* This is a dark-brownish liquid that changes to a colorless gas and has an odor that has been described as that of horseradish or garlic. Mustard gas is especially soluble in animal fat, which accounts for its rapid penetration into the skin and the lid margin. It is not dissolved in lacrimal secretion, but acts upon cornea and conjunctiva as a protoplasmic poison, extending damage from cell to cell deep into the tissue. Mustard gas vaporizes slowly, and its emanation from contaminated articles forms a continued source of danger. Repeated minimal exposures are cumulative in their effect.

Godwin,<sup>16</sup> in a review of the literature, summarized the symptoms, clinical picture of the severe type, and the pathology.

*Symptoms.* After exposure to mustard vapor, a latent period of from 2 to 48 hours precedes symptoms; if liquid is contacted, almost immediate discomfort is experienced. A burning sensation is followed by pain in and about the eye, accompanied by a sandy feeling under the lids. Lacrimation is profuse, and blepharospasm may be intense enough to dam back the tears and prevent voluntary opening.

*Clinical Picture of Severe Type.* The exposed cornea becomes devitalized, revealing an "orange-peel" texture, or it may be eroded. Iris spasm produces miosis. The surface conjunctiva is destroyed,



and the resulting necrotic membrane as well as its underlying coagulative exudate may exert enough tissue pressure to blanch the circulation and prevent chemosis. The remainder of the conjunctiva is affected less, and may be chemotic to the extent of prolapse. During resolution, the pale area corresponding to the palpebral aperture (which may be mistaken at first for the more normal area) gains chemosis, as pressure is released, before final blanching occurs. Convalescence is gradual and may require several months.

*Pathology.* The pathology of severe corneal burns from mustard gas has been described in the rabbit,<sup>17, 18</sup> and in man.<sup>19</sup> The epithelium is destroyed immediately, and, within 15 minutes, edema and necrosis of the stroma follow. After five hours, polymorphonuclear infiltration appears at the limbus and spreads into the stroma. A week later, edema subsides, and the opacity improves. Vascularization of the area continues for weeks. After several years, the area may be subject to recurrent ulceration. Fibrosis forms the picture of healing.

Severe and progressive ocular injuries may be induced by prolonged exposure to a concentration as low as 1:10,000,000. Splashing of the liquid into the eye always causes a very destructive lesion.

Ocular involvement was found to be present in 75 to 90 percent of all mustard-gas casualties. These divide themselves into three groups:

1. In 75 percent of the cases there was a mild conjunctival irritation that cleared in one to three weeks with symptomatic treatment.

2. Severe conjunctival involvement was found in 15 percent, with a horizontal band of white chemosis between the lids. Recovery took place in from four to six weeks.

3. The third group, comprising 10 per-

cent of cases, showed corneal erosion. In this group two to three months were required for convalescence. In spite of potential danger serious immediate complications were infrequent in the war of 1914-1918.

Since no fully satisfactory neutralizing agents have been found which will be tolerated by the eye, prophylaxis is important. As soon as the first odor of horse-radish is detected the gas mask should be put on immediately.<sup>19</sup> When the mask is taken off care should be exercised so that the eyes are not rubbed, as the hands may be contaminated and thus injure the eyes.

*Treatment.* The treatment is that recommended by Gifford<sup>20</sup> in the Military Surgical Manual on Ophthalmology of the National Research Council, and is summarized in the chronologic sequence of treatment.

1. Reassure the patient by opening the lids so that he can see he is not blind. It may be necessary to use pontocaine or butyn, but no cocaine.

2. Each eye is to be irrigated two minutes with 1.5-percent solution of sodium bicarbonate; 0.9-percent saline, or 7-percent boric-acid solution. Of these the sodium bicarbonate is probably the most desirable and most easily prepared, in a solution of a teaspoonful to a glass of water.

3. If photophobia is marked or the cornea is involved atropine is instilled until symptoms or the iritis subsides.

4. If there are several corneal or conjunctival lesions, after 24 hours instil liquid paraffin, cod-liver oil, vaseline, or mineral oil to prevent adhesions. This lapse of time is to allow the patient to leave the gassed area or allow time for the gas to disappear, as the oil serves to concentrate mustard gas and if the gas is still present in the area it would do further damage to the eye.

5. Dark glasses—*do not bandage*. The dark glasses should be removed as early as possible to prevent neurasthenic symptoms.

6. Mild silver protein, 10 percent, followed by boric irrigation, three times daily in severe cases.

7. The action of mustard gas on the cornea produces a good bacteriologic medium, so secondary infection is fairly common. When this is present sulfathiazole ointment is indicated. It should not, however, be used routinely, as experience has shown that in a clear wound it retards healing. During convalescence 0.25-percent zinc sulphate drops with adrenalin are advised.

*Lewisite*. This is a brown liquid that changes to a colorless gas, and has the odor of geraniums. It produces a more immediate, painful, and rapid destruction of the eye than does mustard gas. In addition, constitutional symptoms of arsenic poisoning may develop.

Treatment must be prompt. *Lewisite* is rapidly hydrolyzed and oxidized; hence the use of copious irrigations with 1.5-percent solution of sodium bicarbonate or water is indicated. The treatment of the burns is essentially the same as that for mustard gas.

*Phosgene* is another gas that may be used. It smells like silage and is primarily a lung irritant that may produce collapse and heart failure. The vapor produces only mild irritation of the eyes, which clears uneventfully on symptomatic treatment. Retinal hemorrhage may occur secondarily to anoxemia, which is produced by the pulmonary edema.

In 1914-1918, when gases were used they were mixed. If they are used again they will probably consist of mixtures. Knowing that their pharmacologic action is basically the same, rather than lose time

trying to identify the gas, it seems best to remember that the action may be inhibited by neutralizing hydrolysis. Thus if the eyes, nose, or throat is irritated from possible exposure to gas, it should be washed with a solution of a teaspoonful of baking soda to a glass of water. The hands and face should be washed thoroughly with a good lather of soap and rinsed copiously with water.

### CONCLUSION

In conclusion it seems worthwhile to stress certain fundamental principles that should be kept in mind in dealing with ocular war injuries.

1. Penetrating wounds of the globe, iris prolapse, and lid injury require immediate surgical care if the proper facilities are available. If not, the wounds should be cleaned, a dressing applied, and the patient sent to a base where proper facilities are available. In the event of a lid injury a moist dressing is indicated. In cleaning up lid injuries debridement technique used in other wounds would be ruinous to the lids and conjunctiva where every millimeter of tissue must be saved.

2. As to foreign bodies of the cornea and globe, experience indicates that it is best not to interfere until the patient has recovered from shock and until the foreign bodies can be removed under favorable circumstances. It is also well to remember that minute foreign bodies of the cornea are often spontaneously extruded during the first 24 hours.

3. In cases of thermal burns of the cornea the routine, continued use of anesthetics is to be avoided, as any of the anesthetics interfere with the healing of the cornea. In general it has been found that unless there is some definite indication for the local use of drugs, the eyes recover from injury more rapidly if these are not employed.

4. War-gas burns of the eyes or ex-

posure to war gas requires immediate attention. The most effective universal treatment, irrespective of the type of gas, or in the event of a mixture of gases, would appear to be that based on an alkaline hydrolysis by the use of approxi-

mately 2-percent sodium bicarbonate. This can be simply made by dissolving a teaspoonful of baking soda in a glass of water.

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# OCULAR FINDINGS IN A CASE OF PERIARTERITIS NODOSA

## A CASE REPORT\*

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Periarteritis nodosa can no longer be considered a rare disease, approximately 400 cases having been reported in the literature since it was first described by Kussmaul and Maier in 1866. It is a primary vascular disease involving the small and medium-sized arteries of the muscular type. Pathologically the disease consists of necrosis of the adventitia and muscularis of these vessels and pleomorphic inflammatory cellular infiltration, usually consisting of histiocytes, polymorphonuclear neutrophils, and eosinophiles. Later the endothelium may proliferate and occlude the lumen or become necrotic and lead to thrombosis, or small aneurysms may form due to the weakening of the vessel wall. Since the entire thickness of the wall is affected rather than the adventitia alone, panarteritis nodosa has been suggested as a more accurate name.

There is no agreement as to the cause of the disease. After conducting elaborate studies on rabbits, Harris and Friedrichs concluded that it was produced by an ultra virus, but their work has not been confirmed. Swift, Derick, and Hitchcock described the lesions as a low-grade allergic response to some causative agent, bacteria, or toxin. Cameron and Laidlaw reported a case which they considered due to parasitic infestation. Syphilis has been discarded as a direct etiologic factor. Possibly periarteritis nodosa is the reaction of the arterial system to diverse infectious diseases.

Periarteritis nodosa may occur at any age, although 50 percent of the cases fall in the 20 to 40-years age group. It has been reported more frequently in males in a ratio of four to one. The disease lasts from a few weeks to a year and usually terminates fatally. The onset is often insidious, accompanied by fever, emaciation, weakness, pains in the extremities, joints, and abdomen. Blood pressure is frequently elevated, and renal insufficiency may appear early, late, or in the terminal stage. Many of the symptoms are secondary to the local disturbances in blood supply, and depend on their severity and distribution. When lesions occur in the skin, diagnosis can be made from a biopsy specimen. The nodular lesions on the arteries may attain macroscopic size, but frequently the lesions are microscopic, and a definite diagnosis is made only at autopsy. The vessels of the gastrointestinal tract and the heart are affected in the majority of the cases which are diagnosed *post mortem*, and the vessels of the extremities and the brain in a smaller number.

Eye findings have been reported in relatively few cases. In 1899 Müller described characteristic changes in the retinal arteries in a case of periarteritis nodosa. Similar changes were found in the small vessels of the brain. When Goldstein and Wexler reported in 1929 a detailed study of the eye findings in a case of periarteritis nodosa which came to autopsy, they could find no other reference in the literature to lesions in the ocular vessels. In the same year v. Herrenschwand published one case in which

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a periarteritic nodule was found on the central retinal artery, as well as involvement of the long posterior ciliary vessels. Böck reported a case in which the ciliary arteries were affected, and a second in which there was gross involvement of the vessels of the choroid and ciliary body. Christeller (1926), Friedenwald and Rones (1931), and Halpern and Trubek (1933) each reported one case with lesions in the choroidal vessels, whereas the retinal arteries were normal.

Few fundus reports are found in the literature, and, when mentioned, the eye-grounds were usually normal or renal retinitis was described. In 1935 King reported for the first time papilledema associated with periarteritis nodosa. In his case the diagnosis was made from a biopsy specimen, and the patient recovered. This patient had recurrent subacute uveitis in one eye, followed by secondary glaucoma which necessitated enucleation. Microscopic examination of the eye revealed no involvement of the arteries of the uveal tract, but there were changes in the retinal vessels. In the case to be reported there was also papilledema, and it is unique in that the initial symptom of disease was visual disturbance.

#### CASE REPORT

J. B., a colored man, aged 38 years, was admitted to the eye service of the Cincinnati General Hospital on October 8, 1941, complaining of failing vision of four-weeks' duration. There were no other ocular signs nor symptoms.

The patient gave a history of frequent headaches and dizzy spells upon arising in the morning. Two years earlier a positive Wassermann reaction had been obtained in a routine examination, and the patient had received a year's intensive treatment for syphilis. His mother had died of hypertension at the age of 67 years.

Uncorrected vision was O.D. 20/25, O.S. 20/50; correctable in both eyes to 20/20. Examination of the lids, lacrimal sacs, conjunctivas, corneas, and anterior chambers revealed no pathologic changes. Pupils were round and equal, and reacted to light and in accommodation. The lenses and media were clear. Examination of the fundi oculi led to the following observations: O.D. The disc was round, hyperemic, and elevated two diopters. The margins were blurred, and many small hemorrhages were seen on and around the disc. The retinal arteries were diminished in caliber, and the veins were engorged and tortuous. Venous pulsations were easily discernible. An increased arterial reflex and copper-wire coloring were also noted. The smaller arterioles, especially about the macula, exhibited tortuosity. Pronounced nicking of veins by arteries was present. Many small flame-shaped hemorrhages were seen throughout the retina, but appeared in greater numbers near the macula. The macula also contained colloidlike exudates, areas of fatty and hyalin degeneration. O.S. The picture in the left eye was similar to that in the right except that the papilledema was slightly more pronounced. The peripheral fields of vision were normal in extent. Central fields showed enlarged blind spots. Intraocular tension (Schiötz) in each eye was 19 mm. Hg.

The general physical examination was essentially negative except for blood pressure, which registered 244/156. The blood Wassermann reaction was negative; the urea nitrogen 26 mg. percent. The clinical diagnosis was malignant hypertension and hypertensive retinopathy.

Bed rest and expectant treatment were of no avail. The retinal hemorrhages multiplied, and papilledema increased to five diopters. A month after the first examination the patient developed constant pre-

cordial pain, and the possibility of coronary occlusion was considered. A few days later an aortic diastolic murmur and palpable and audible gallop rhythm were present. The blood urea nitrogen was 60 mg. percent. The patient became comatose and died the following day, six weeks after hospitalization.

The autopsy was performed by Dr. Harvey W. Hessler, of the Pathology Department, Cincinnati General Hospital. Anatomic diagnosis: Malignant nephrosclerosis; pulmonary congestion and edema; lobular pneumonia and pulmonary infarcts; marked left ventricular myocardial hypertrophy and cardiac dilatation; chronic passive congestion of the liver and spleen; syphilitic aortitis; chronic cholecystitis; chronic interstitial prostatitis; chronic epididymitis; chronic pulmonary emphysema; petechial hemorrhages in the pleurae; cerebral edema.

At autopsy the posterior half of the left eye was removed and sent to the Holmes Hospital Ophthalmological Laboratory. The pathologic diagnosis was: Retinopathy of malignant hypertension; marked arteriolar sclerosis of the choroid; papilledema.

Microscopic description: The arteries in the choroid showed very marked changes in their walls whereas the veins and choriocapillaris were relatively unaffected. In some arteries there was hypertrophy of the media, in others great thickening of the intima sometimes producing occlusion, or a combination of both. In some vessels the walls appeared to be hyalinized and almost structureless, but necrosis was not conspicuous and there was practically no cellular infiltration.

Fluid had collected beneath the retina, and the edema of the retina itself was marked, especially in the peripapillary and macular regions. Occasional small hemorrhages were scattered throughout the

retina, and were much more numerous around the disc and macula. In the latter area many occurred in the outer nuclear layer. The larger retinal arteries showed thickening of the media, but the changes were much less marked than in the chorioidal vessels. Papilledema had produced a broad neuritic roll displacing laterally the retinal layers. There were edema deposits in the internuclear layer, especially large and numerous in the macular area. Some were fibrinous, others hyalin in appearance; a few contained macrophages. Near the posterior pole the internal limiting membrane was detached in many places.

Because of the interesting vascular lesions presented, all of the microscopic sections of this case were referred to Dr. Pearl M. Zeek, Pathology Department, for special study. She stated that in her opinion this case presented a combination of: 1, advanced generalized arteriosclerosis with terminal focal arteriolonecrosis; 2, focal syphilitic arteriolitis; and 3, focal periarteritis nodosa. The kidney pedicle, gall bladder, testis, epididymis, and prostate presented all three types of lesions, while in certain other locations only one or two of them were found. In the choroid the predominating vascular lesion was arteriosclerosis with slight terminal necrosis. A few vessels in both retina and choroid showed inflammatory changes suggesting in some syphilitic arteriolitis and in others early periarteritis nodosa. Certainly the sum total of the departures from normal in the eye was not typical of any one of the three conditions, but represented the result of a combination of inflammatory and degenerative vascular lesions.

#### DISCUSSION

In reviewing 100 cases of periarteritis nodosa for the sequence of symptoms, Boyd found that only one patient had

complained first of the eyes. Ocular manifestations appeared in every stage of the disease but were relatively rare, only one fourth of the patients complaining of them. The nature of the ocular signs and symptoms was not stated.

Goldstein and Wexler were the first to describe intraocular vascular lesions in a case of periarteritis nodosa. These were found only in the choroidal arteries in the eye, and were rather atypical. Ophthalmoscopic examination was made only once in this case and was negative. Friedenwald and Rones reported a case of periarteritis nodosa which developed typical albuminuric retinitis while under observation. The patient died a month later. Microscopically, there was marked arteriolar sclerosis of retinal and choroidal vessels, but no inflammatory lesion in the retina, and only a few small vessels in the choroid showed suggestive mononuclear infiltration. Several typical periarteritic nodules were seen in short ciliary arteries just outside of the sclera. The authors concluded that ophthalmoscopically and microscopically the retinal picture did not differ from that found in uncomplicated cases of albuminuric retinitis. In King's case, the first in which true papilledema associated with peri-

arteritis nodosa was described, the excised eye showed intense subacute uveitis. The retina was also involved in the inflammatory process, the arteries and periarterial zones being chiefly affected. No characteristic lesions were found in the arteries of the uveal tract.

In our case arteriolar sclerosis was extreme in the choroidal vessels, moderate in the retinal arteries. The suggestive inflammatory changes in the vessels, described by Dr. Zeek were relatively slight. The ophthalmoscopic and pathologic picture of retinopathy did not appear to differ from that in other cases of malignant hypertension. In our opinion fundus lesions directly due to periarteritis nodosa of ocular vessels have not been described. The caliber of intracular vessels may be a factor in the rare occurrence of eye lesions in this disease, since the vessels in the eye are smaller than those usually affected by periarteritis nodosa in other organs of the body.

#### SUMMARY

Failing vision due to retinopathy typical of malignant hypertension was the first symptom in a proved case of periarteritis nodosa.

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## A SUMMARY OF FINDINGS AT THE EYE EXAMINATION OF PREPARATORY-SCHOOL BOYS\*†

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As a part of the annual medical examination of their students many preparatory schools and colleges include some sort of inspection of the eyes, a test for visual acuity, and a color-vision test; the results of such tests in colleges have been summarized by Diehl,<sup>1</sup> who reports that about 11 percent have uncorrected or inadequately corrected defects. This type of testing may discover a significant number of individuals who should be referred to an ophthalmologist for a more thorough examination, but even when rigid conditions regarding distance and illumination of charts are observed, these tests do not appear to be very efficient, and it has seemed desirable to attempt to develop more satisfactory screening devices. Recently an improved method of testing the vision of school children has been reported by one of us (A. E. S.<sup>2</sup>).

At the beginning of the school year 1940, 741 preparatory-school students

were given an eye examination according to the method described below, and at the beginning of the school year 1941, 715 students at the same school were given a similar examination. The results of these examinations and some observations upon them are herein reported. It has been our purpose to develop and evaluate various procedures that can be used to select those individuals who require an examination by an eye specialist and, by reporting our findings in this group, to emphasize the desirability of giving members of similar groups an eye examination. The results of our examination will suggest the answer to the question of whether the economic status, privileged background, and opportunity for adequate medical care of the average preparatory-school student are valid reasons for omitting a careful test of the vision from his annual medical examination. All but about 4 percent of these students have always been resident in the United States. Approximately 60 percent of these students came from families having incomes ranging from \$3,000 to \$20,000 a year, and about 20 percent were from families whose income is usually greater than the latter amount. They ranged in age from 13 to 19 years. The results of the 1,456

\* This study was aided by a grant from the Carnegie Corporation.

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examinations concern 1,009 different individuals; 447 individuals were examined in both 1940 and 1941.

The examinations, the results of which we are reporting, included several procedures that are not essential parts of an adequate vision-testing program; many procedures were carried out so that the relative efficiency of different tests might be evaluated, and so that standards for some tests might be established. In the 1941 survey some of the methods used in 1940 were altered and a few new procedures were introduced.

In both the 1940 and the 1941 surveys the services of three individuals were used; namely, two technicians and one ophthalmologist. Each student was first seen by one of the technicians who entered his name, age, the date, and his serial number upon a specially prepared form; subsequently this technician recorded the responses to a color-vision test (in 1940 the Ishihara and in 1941 the pseudo-isochromatic plates<sup>3</sup> of the American Optical Company were used), and recorded a brief history that included answers to such questions as when were glasses last prescribed, and whether such symptoms as headaches, blurred vision, or red eyes were present. In the 1941 survey the history taking was done by the ophthalmologist.

The next part of the examination was carried out by the second technician, who used in 1940 a battery of tests which have been previously described by one of us as the Massachusetts vision test.<sup>2</sup> This test includes (1) a determination of visual acuity of the right, left, and both eyes, expressed in terms of the Snellen fraction; (2) a +1.50D.-sphere test for the detection of latent hypermetropia; and (3) an estimation of the degree of heterophoria present. Visual acuity was tested by means of an artificially illuminated Snellen chart placed 20 feet from the sub-

ject, and the vision for each and both eyes was recorded; if glasses were worn by the subject, naked vision was not tested. The test for latent hypermetropia was carried out by instructing the examinee to attempt to read the Snellen chart through a pair of +1.50D. spheres mounted in zylonite frames; ability to read the 20/20 line was scored as a failure. For the measurement of heterophoria two pairs of zylonite frames were used: one frame contained a red multiple Maddox rod for the right eye mounted horizontally and no lens for the left eye, and the other frame contained a red multiple Maddox rod mounted vertically for the right eye and no lens for the left eye. When the test is made at 20 feet the object of fixation is a small clear 5-watt bulb that projects through the window of a picture of a house: the lateral dimensions of the house are calibrated to be equivalent to 6 prism diopters of esophoria and 4 prism diopters of exophoria at a distance of 20 feet, the vertical dimension of the window is equivalent to 1.25 prism diopters of right and left hyperphoria; the presence of the projected vertical streak through the house or the horizontal streak in the window constitute a successful performance. The near-phoria test was made by utilizing a pinhole light source with a pencil type of flashlight concealed in a block of wood whose width was calibrated for 6 prism diopters of esophoria and 8 prism diopters of exophoria, and whose face had a small picture for fixation so that accommodation would be used. A 16-inch cord was attached to the block so that a proper distance from the subject could be maintained. The presence of the vertical streak within the margins of the block constituted a successful performance. No quantitative measurements of heterophoria were made. Each subject was marked as either passing or failing each of the three tests.

In addition to these three tests the technician also measured the near points of accommodation for each eye, noting the nearest point at which fine print could be seen clearly. In the 1941 survey this technician measured visual acuity by means of a Snellen chart as in 1940 but recorded data for naked vision as well as vision with glasses wherever glasses were worn; determined the presence of latent hypermetropia as in 1940; measured the near points of accommodation for each eye as in 1940; and made quantitative measurements of heterophoria. In 1941 the measurements of muscle balance made at 20 feet utilized the Maddox rod and a chart calibrated from 1 prism diopter to 12 prism diopters on the horizontal and from 1 prism diopter to 6 prism diopters on the vertical axis. When heterophoria was measured at 16 inches a displacing prism test (Graefe) was used and quantitative data recorded.

The third part of the examination was carried out by the ophthalmologist. He noted any abnormalities of the external eyes, pupils, and fundi; recorded the results of a cover test for muscle imbalance; determined the refractive error by retinoscopy; determined the near point of convergence; and made a recommendation on the basis of all the data that had been obtained. In the 1941 survey the ophthalmologist recorded the vision history. The cover-test results were roughly classified as zero, mild, moderate, or marked, depending upon the amplitude of recovery movement noted; in 1941 this test was made by utilizing a bar of prisms and the results were expressed in prism diopters. The refractive error as determined by retinoscopy in both 1940 and 1941 was recorded under emmetropia, hyperopia, hyperopic astigmatism or mixed astigmatism, and the degree of the conditions was considered, arbitrarily, low (0 to 1D.),

moderate (1D. to 2D.), or high (over 2D.). The determination of the refractive error was made quickly by using only five lenses ( $-0.50D.$  sph.,  $+0.50D.$  sph.,  $+1.50D.$  sph.,  $+2.50D.$  sph., and  $+3.50D.$  sph.) at a skiascopy distance of 26 inches and by having the examinee fixate a remote object; the error was fixed as that occurring between those two succeeding lenses which gave a "with" and "against" movement. The near point of convergence was determined objectively by noting that distance at which binocular fixation was lost to an approaching pencil point. In the 1941 survey the ophthalmologist asked questions relating to the type, frequency, and severity of headache; how long glasses had been worn; how recently vision had been examined, and how constantly glasses were worn; whether or not blurred vision at distance and near was present; and whether "car sickness," red eyes, or diplopia was occasionally noted by the subject. At the completion of the examination the ophthalmologist made one of the following recommendations: *Pass*—this decision was made when there was no refractive error, when the subject had been recently examined and adequately treated, and when the examinee has some error for which he could adequately compensate and from which he had no symptoms; *Refer*—this decision was made when there was indication for further examination of the eyes either on the basis of some abnormality or because of the presence of symptoms referable to the eye; and *Refer, symptoms*—this decision was made on all borderline cases and implied that a further eye examination should be made if symptoms of eyestrain or other indications should develop in the future.

The division of the procedures of this examination among three individuals and the inclusion in it of only such tests as

could be performed quickly and without complicated instruments made it possible to complete the tests within a five-minute period. The present report describes our results with a variety of tests and it should be emphasized that we do not advise that all or even the majority of these procedures be included in any adequate visual examination designed to screen out those individuals who should be referred to an eye specialist for further study.

### RESULTS

1. *Color vision.* About 5 percent were found to have deficient color vision. A report describing a brief method of testing color vision and using pseudo-isochromatic plates has recently been published.<sup>4</sup>

2. *Headache.* In the 1940 examination the questions regarding headache were asked by a technician, and 23 percent of the group were recorded as having headache; in the 1941 examination questions regarding headache were asked by the ophthalmologist, and, although 16 percent were recorded as having headache, in only 3 percent of the group was this symptom considered significant. Care in wording and manner of asking these questions and experience in the interpretation of replies are necessary.

*Blurred vision.* In the 1940 examination, when the questions were asked by the technician, about 5 percent were recorded as having blurred vision for near and 17 percent for distant objects. At the 1941 examination about 18 percent were noted as having blurred vision for near and about 5 percent for distant objects; about 12 percent more complained of blurred vision for distant objects when glasses were not worn.

*Red eyes.* Sixteen of the 715 in the 1941 group (2.2 percent) complained of redness of the eyes; at the 1940 examination 14 percent (of 741 students)

were recorded as having this symptom.

*Car sickness.* This symptom was present in seven members of the 1941 group. It is our impression that many of the group used to have this symptom during their earlier years but these data were not recorded.

3. *Visual acuity.* In the 1940 examination the vision for the poorer eye, with glasses if glasses were worn, was recorded. Eighty-two percent were found to have 20/20 vision; 7.7 percent had 20/30; 6.5 percent had 20/40; 1.5 percent had 20/50; 0.8 percent had 20/70; and 1.2 percent had 20/200 vision in the poorer eye.

In 1941 the visual acuity of each and both eyes without glasses was measured and recorded for the entire group. The complete data are given in table 1. It will be seen that visual acuity in either eye was 20/20 in about 75 percent of the group, between 20/30 and 20/70 in about 12 percent, and 20/100 or less in approximately 13 percent. Of those in the group who had no glasses 6 (1.3 percent) had 20/30 vision in either eye and 13 (2.7 percent) had less than 20/30 vision in either eye.

Glasses were worn by 249 (34.8 percent) of this group; visual acuity with glasses for both eyes was found to be 20/20 in 87 percent, 20/30 in 8.8 percent, 20/40 in 3.2 percent, and only one individual had 20/70 and one other 20/100 vision.

Glasses were owned by 41.6 percent of the 1940 group; 18 percent of these wore their glasses very rarely, 65 percent wore them only for reading, and the remainder wore them constantly.

*Cover test.* In 1940 the cover-test results were classified qualitatively. At near, 65 percent were recorded as having orthophoria, 1.93 percent as moderate esophoria, and 15 percent as moderate exophoria. At distance, 94 percent were rated

orthophoria, 1.5 percent as moderate esophoria, and 2.6 percent as moderate exophoria. In 1941 quantitative measurements were used. With this test 5 (0.6 percent) had esophoria of more than 6 prism diopters at near and 23 (3.2 percent) had 8 or more prism diopters of

of exophoria. Quantitative measurements of heterophoria were not made in 1940. Eight (1 percent) failed the test on the vertical axis, 24 (3.2 percent) failed on the horizontal at distance, and 23 (3.1 percent) at near. In 1941 quantitative measurements of muscle balance were

TABLE 1

VISUAL ACUITY OF MEMBERS OF THE 1941 GROUP TAKEN WITHOUT GLASSES WHETHER OR NOT GLASSES WERE USUALLY WORN

	No. O.D.	Percent	No. O.S.	Percent	No. O.U.	Percent
20/20	539	75.70	550	77.36	570	80.06
20/30	25	3.51	22	3.09	21	2.95
20/40	20	2.81	23	3.23	27	3.79
20/50	13	1.83	13	1.83	12	1.69
20/70	23	3.23	20	2.81	21	2.95
20/100	18	2.53	17	2.39	18	2.53
20/200	51	7.16	49	6.89	29	4.07
5/200	4	0.56	4	0.56	1	0.14
10/200	19	2.67	13	1.83	13	1.83
Not recorded	3	0.42	4	0.56	3	0.42
Total	715		715		715	

exophoria. At distance, 5 (0.6 percent) had esophoria greater than 8 prism diopters, and 6 (0.8 percent) had exophoria greater than 6 prism diopters.

4. *Hypermetropia*. A significant degree of hypermetropia is considered to be present when the 20/20 line can be read by either eye through a +1.50D. lens. The data obtained by this test were similar in 1940 and 1941; in the latter year 3.7 percent had 20/20 vision through a +1.50D. lens before the right eye, 3.2 percent had 20/20 when that lens was held before the left eye, and 7.5 percent when +1.50D. lenses were held before both eyes. Of the 466 individuals who did not have glasses 46 (10 percent) had 20/20 vision through the +1.50D. lens with either or both eyes.

5. *Heterophoria*. Failure for distance was recorded when more than 6 prism diopters of esophoria or 4 prism diopters of exophoria or 1.50 prism diopters of hyperphoria were present; failure at near was recorded for more than 6 prism diopters of esophoria or 8 prism diopters

made. With the Maddox rod 10 (1.3 percent) were found to have a distance vertical phoria of more than 1.50 prism diopters, 2 (0.2 percent) distance horizontal esophoria of more than 8 prism diopters, and 7 (0.9 percent) a distance horizontal exophoria of more than 6 prism diopters. With the displacing prism test (Graefe) at 16 inches, 8 (1.1 percent) individuals were found to have esophoria of 6 prism diopters or more and 20 (2.7 percent) to have exophoria of 8 diopters or more. Tables 2, 3, and 4 show the distribution of these measurements within the 1941 group.

Of the group who had 20/20 vision in both eyes or 20/30 in either eye there were 8 who had more than 1.50 diopters of hyperphoria, 25 who had more than 6 diopters of esophoria (distance), 7 with more than 4 diopters of exophoria (distance), 3 had more than 6 diopters of esophoria (near), and 8 had more than 8 diopters of exophoria (near). All three of the individuals who had more than 6 diopters of esophoria at near were also in-

cluded in either the hyperphoria or esophoria (distance) group; but only 2 of the 8 with more than 8 diopters exophoria (near) were included in any of the other groups. Only 4 of the 25 who had more

TABLE 2

DISTRIBUTION OF HYPERPHORIA MEASUREMENTS (MADDOX ROD) IN MEMBERS OF 1941 GROUP

	No.	Percent	No.	Percent
R. H.				
$\frac{1}{2}$	1	.14		
1	74	10.56		
$1\frac{1}{2}$	8	1.14		
2	3	.43		
3	2	.29		
4	2	.29		
Total			90	12.84
L. H.				
1	7	1.00		
2	2	.29		
3	0			
4	1	.14		
Total			10	1.40
Orthophoria			600	83.91
Not recorded			15	2.10
Total			715	

Note: The high incidence of right hyperphoria (90 cases) as compared with left hyperphoria (10 cases) is probably related to the fact that the tests were made with the Maddox rod always before the right eye.

than 6 diopters of esophoria (distance) were included in other groups. There were 45 different individuals (6.2 percent of the 715 individuals) all of whom had either 20/20 vision in both eyes or 20/30 vision in only one eye who had a significant degree of heterophoria.

6. *Near point of accommodation.* In 1940 the range of near-point accommodation (O.S.) was from 7 to 13 cm.; in 1941 it ranged from 5 to 16 cm.; the mode fell at 10 cm. each year. The range (O.D.) in 1940 was from 7 to 13 cm. and in 1941 from 6 to 15 cm.; the mode fell at 10 cm. each year. It should be noted that the near point cannot be considered as an index of amplitude of accommodation, since the refractive error was not

corrected when this distance was measured.

7. *Near-point convergence.* As measured objectively 17 (2.4 percent) were found to have a near point of convergence greater than 12 cm. in 1940, and 14 (1.9 percent) a measurement greater than 14 cm. in 1941; about 40 percent each year had a near point of less than 7 cm.,

TABLE 3

DISTRIBUTION OF ESOPHORIA AND EXOPHORIA MEASUREMENTS AT DISTANCE (MADDOX ROD) IN MEMBERS OF THE 1941 GROUP

	No.	Percent	Total No.	Percent
Esophoria				
1	154	21.60		
$1\frac{1}{2}$	3	.42		
2	117	16.41		
$2\frac{1}{2}$	1	.14		
3	57	7.99		
4	33	4.63		
5	11	1.54		
6	22	3.09		
7	14	1.96		
8	14	1.96		
9	0	0		
10	2	.28		
Total			428	60.03
Exophoria				
1	60	8.42		
$1\frac{1}{2}$	1	.14		
2	31	4.35		
3	12	1.68		
4	4	.56		
5	1	.14		
6	3	.42		
7	2	.28		
8	3	.42		
9	0	0		
10	0	0		
11	1	.14		
12	1	.14		
Total			119	16.69
Orthophoria	166	23.28	166	23.28
Not recorded	2	.28	2	.28
Total	715		715	

but in only 5 out of the 715 members of the 1941 group was the near point less than 4 cm. Our experience with this test raises the question of whether more accurate measurements can be obtained by

taking a single observation or by taking the average of a series of observations: this problem should be further investigated.

8. *External eye and fundus.* In 1940, 25 individuals were found to have some

TABLE 4  
DISTRIBUTION OF ESOPHORIA AND EXOPHORIA  
MEASUREMENTS AT NEAR (GRAEFE) IN  
MEMBERS OF THE 1941 GROUP

			No.	Percent
Esophoria				
1	49	7.21		
2	23	3.38		
3	6	.88		
4	7	1.03		
5	1	.15		
6	3	.44		
7	1	.15		
8	2	.29		
11	1	.15		
12	1	.15		
Total			94	13.82
Orthophoria	215	31.62	215	31.62
Exophoria				
1	96	14.12		
2	149	21.91		
3	29	4.26		
4	42	6.18		
5	6	.88		
6	24	3.53		
7	5	.74		
8	6	.88		
9	2	.29		
10	8	1.18		
11	1	.15		
13	2	.29		
14	1	.15		
Total			371	54.56
Not recorded			35	4.90
Total			715	

abnormality of the external eye or fundus: in 8 of these it was strabismus. At the 1940 and 1941 examinations there was a total of 16 cases of strabismus (1.5 percent of individuals examined): 14 of these were nonparalytic, 1 was of paralytic origin, and 1 was associated with the congenital absence of a muscle; 6 were diagnosed esotropia, 6 exotropia, 2

hyperesotropia, 1 exohypertropia, and 1 Duane's retraction syndrome. At the 1941 examination the 15 following conditions (2 percent) were also noted: hyperemic lid margins, 2; hyperemic conjunctivitis, 4; squamous blepharitis, 1; follicular conjunctivitis, 1; hyperemic bulbar and palpebral conjunctivitis, 1; chorioretinitis, inactive, 1; pigmented nevus, congenital, 1; pseudo-optic neuritis, 1; myopic conus, 1; hyperopic fundi, 1; healed chorioretinitis, 1. Two of these 15 would have been referred to an ophthalmologist on the basis of other findings, 11 were referred on the basis of these findings alone (1.5 percent of the 715 individuals), and 2 were not referred.

9. *Recommendation.* In 1940 about 70 percent and in 1941 68 percent of the individuals examined were considered to have satisfactory vision and no further examination was advised. About 20 percent were advised to have a more thorough examination in both 1940 and 1941; about 10 percent in both 1940 and 1941 were advised to visit a specialist if symptoms referable to the eyes developed.

In 1940, 154 individuals (20.7 percent) were classified "refer" and 52 of these passed part I (normal visual acuity) of the Massachusetts vision test. The reasons for referring these 52 for a further examination were as follows: failure of part II (+1.50D. test) of the Massachusetts vision test, 28; failure of part III (Maddox rod), 7; because of symptoms of "eyestrain," 10; on the basis of the external and fundus examination, 6; and 1 because of the long interval which had elapsed since his very deficient vision had been carefully checked.

A future report<sup>5</sup> will suggest an adequate screening eye examination for use in adolescent groups and give findings based upon our experience with that method. The data given in this report have helped us in the development and selec-

tion of techniques for use in that examination.

#### SUMMARY

1. Findings in various parts of an eye examination of a group of 1,009 preparatory school boys are given.

2. The data indicate the importance of adequate screening eye examinations as a part of any health program involving adolescents.

3. The desirability of including tests of hypermetropia and heterophoria as well as of visual acuity in any screening examination is shown.

4. Questions regarding blurred vision, red eyes, and headaches are best asked by

a physician: the evaluation of such symptoms will not be helpful unless the history has been carefully taken.

5. There are at present no valid reasons for omitting annual eye tests even among children of the more privileged economic group.

6. The Snellen test is inadequate for the selection of all children in need of a careful eye examination.

7. The recommendation, on the basis of screening tests, for a further careful examination is better made by a physician after a consideration of all of the findings than by lay persons relying on set quantitative measurements alone.

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# A VISUAL PHENOMENON RELATED TO BINOCULAR TRIPLOPIA\*

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After undergoing operation for concomitant strabismus, patients frequently pass through a stage in which there is a rivalry between normal and anomalous correspondence. The innate, normal sensorial relationship is reawakened, but the anomalous relationship is not as yet completely suppressed. As a result, two directional localizations are attributed to the foveal stimulation of one eye. These two directional localizations are present, as a rule, only successively; at one time the foveal stimulus is localized in a normal, at another in an anomalous way. In certain cases, however, the normal and anomalous localizations occur simultaneously, and, as a result, the stimulus is localized at the same time in two different directions. This striking phenomenon is known as *monocular diplopia* or *binocular triplopia*. It is infrequently met with and can often be demonstrated for only a fleeting moment. In other cases it is found more or less constantly and can be observed in the same patient over a number of years.

Binocular triplopia is seen not only in the postoperative stage of concomitant strabismus; it may occur whenever there is a rivalry between normal and anomalous correspondence. This is the case with patients who have a facultative divergent strabismus. When these patients keep their eyes parallel for distance by an effort of convergence, they localize bifoveal stimuli in a normal way; when their eyes are dissociated, they localize these stimuli anomalously. It may happen that both modes of localization are pres-

ent simultaneously and that the patient has binocular triplopia.

I have had the opportunity to observe a phenomenon related to this type of binocular triplopia. It is of sufficient interest to deserve to be reported.

## CASE REPORT

A graduate student, aged 22 years, came for examination complaining of eye-fatigue and headaches while doing close work. He has worn glasses since the age of eight years, at which time it was first noticed that his eyes had a tendency to turn out. He has worn glasses intermittently and is aware of which eye he uses, because of a difference in the size of the objects when looked at with the right and the left eye. He stated that for distance he uses the left eye and for near the right eye when he does not wear glasses; when wearing glasses, he uses the right eye for distance and near. He has never experienced diplopia.

His refraction showed a considerable anisometropia; with the right eye he saw 20/20 with a  $-5.50\text{D. sph.} \approx 1.00\text{D. cyl. ax. } 180^\circ$ ; with the left eye he saw 20/20-2 with a  $-0.25\text{D. sph.} \approx -0.25\text{D. cyl. ax. } 180^\circ$ . Inspection of the eyes and ophthalmoscopic examination revealed no pathologic condition of the eyeballs.

Analysis of the neuromuscular apparatus disclosed the following findings: In the cover test the patient had, under refractive correction, an alternating divergent strabismus of 15 arc degrees for distance. There was no deficiency in the horizontal movements of either eye; if anything there was a slight excess of adduction in both eyes; in the extreme po-

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sitions there was a jerky rotary nystagmus. Both inferior oblique muscles showed some overaction. The patient most of the time had binocular fixation for distance and his near point of convergence was excellent when he concentrated. In the double-image test<sup>1</sup> there was a crossed diplopia of 15 arc degrees when the patient fixated the light at the center of the Maddox cross with his left eye (*normal correspondence*) and an *uncrossed diplopia* of 15 arc degrees when he fixated with his right eye (*anomalous correspondence*). In the afterimage test<sup>2</sup> the *positive* afterimages were always localized *anomalously*, the *negative* afterimages were almost always localized *normally*; only rarely were the latter in an anomalous relative position. The double-image test and the afterimage test were repeated a number of times and the results were always the same.

Once, however, after considerable testing with the stereoscope had been done, the patient stated during a double-image test, while the red glass was in front of the left eye: "This is very strange. The red light is between the white light and the number one to the left. Yet the distance between the two lights seems much larger. It should be around number six or seven to the right."\* This phenomenon could then be reproduced time and again when the red glass was in front of the left eye; it did not take place when the red glass was in front of the right eye. A few hours later the phenomenon took a somewhat different shape. When the red glass was in front of his left eye, the patient reported: "I see the red light at six or seven to the left, but the mental impression I get is that it is way to the

right of zero." Again this did not occur when the red glass was in front of the right eye.

At the stereoscope, the patient at first had alternating uniocular vision, then diplopia, and finally binocular single vision. It took a considerable time until this stage was reached. He then had stereoscopic depth perception with the large Dahlfeld circles, but none with fine graduated cards such as the Keystone DB<sub>6</sub> chart.

### DISCUSSION

The salient features of this case can be summarized as follows: The patient has a very large anisometropia; he has an alternating divergent strabismus which has undoubtedly existed since early childhood; but which he is able to overcome by a convergence effort. He has been in the habit of keeping his eyes straight much of the time and as a consequence a particular sensorial condition has developed which can be observed frequently in cases of facultative divergent strabismus: When the eyes are associated, the retinal correspondence is normal; when the eyes are dissociated, the retinal correspondence is of an anomalous type. This is quite evident in this case from the afterimage test. In the darkened room, where there is no incentive for the patient to keep his eyes straight, the afterimages are always localized in an anomalous way, the angle of anomaly being equal to the angle of squint. In the lighted room the patient can, but does not always keep his eyes straight. Hence, the localization of the afterimages is alternately normal and anomalous.

The result of the afterimage test in this and similar cases must not be misconstrued as meaning that the localization of the afterimages depends upon the position of the eyes during the test. In the afterimage test the visual direction or directions of the two foveas are directly deter-

\* The patient was seated at 2½ m. from the center of the Maddox cross so that the value of the large numbers referred to has to be multiplied by 2 in order to express the angular distance of the double images in arc degrees.

mined and they are independent of the relative position of the eyes. The localization of the afterimages has changed because of a change in the sensorial retinal relationship, which in this case is produced by the dissociation of the eyes.

Another interesting observation is the difference in localization in the double-image test, according to which eye the patient uses for fixation. The localization is normal when the patient fixates with his left eye and anomalous when he fixates with his right eye. It can be found relatively often in cases of unilateral strabismus that such a difference occurs with change in fixation.

In these cases normal correspondence can sometimes be elicited in the double-image test when fixation is shifted from the leading eye to the usually deviated eye. This phenomenon can be explained by the fact that anomalous correspondence represents an adaptation of the sensorial retinal relationship to the changed motor conditions. When the patient is placed under conditions of seeing that are unusual for him—for example, when he is forced to fixate with the eye which, as a rule, is deviated—the normal, innate retinal relationship may be reawakened. In alternating strabismus, in which the patient presumably uses or has used both eyes more or less equally, a change in retinal correspondence with change in fixation would not be expected. The patient under discussion does, in fact, pre-

fer to use his right eye, at least when he wears his correction, although this eye has a much higher refractive error. It has, however, a slightly better visual acuity. This case cannot be classified, therefore, as a completely alternating one; some preference in fixation is given to the right eye.

The two phenomena which were discussed are interesting, but by no means unique. The singular feature in this case is the simultaneous presence in the double-image test of two modes of localization of biretinal stimuli which is akin to binocular triplopia. When the red glass is in front of the patient's left eye—the weaker eye, and only then—the patient sees the red light in a position indicating an anomalous localization. At the same time the simultaneous presence of a second visual direction, pertaining to the same stimulated element of the retina of the left eye, is evident from the patient's statement that there seems to be a much greater distance between the red and the white light and that, although the red light is to the left of the fixation light, it "ought to be way to the right" or "around 6 or 7 to the right." There is no actual monocular diplopia, but the phenomenon demonstrated by this highly intelligent and observing patient can be considered as a precursor to binocular triplopia.

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# NOTES, CASES, INSTRUMENTS

## BILATERAL CONGENITAL COLOBOMA OF UPPER LIDS

### CASE REPORT

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The congenital anomaly of the external eyes herewith presented is deemed of interest in the study of developmental ocular defects. No other case report of similar congenital malformation is noted in the literature.

The patient R. R., a Mexican boy, aged four years, was admitted on October 14, 1942, to the John Sealy Hospital because of a developmental defect of both upper eyelids.

No contact with the parents was possible under the circumstances. A social service worker who had been in the home was able to observe that no member of the immediate family was afflicted with any type of gross malformation of the external eye.

*General examination.* Systemic physical findings were essentially negative, although marked mental retardation was apparent; except for the eyes, no other congenitally anomalous condition was noted. Laboratory findings were all within normal limits.

*Ocular examination.* Both upper eyelids presented a similar coloboma, involving approximately one half of the entire width of the eyelid. Nasally, a caruncle of tissue was preserved in which the upper lacrimal puncta were present in both eyes. The lateral portion of both lids was apparently normal in structure; the lid margin of this portion contained a normal distribution of cilia. Action of the orbicularis oculi was deficient; in attempted closure lateral traction of the upper lid remnant was noted. During sleep it was

observed that the inferior nasal quadrant of the cornea was exposed, more in the right eye than in the left. Both lower lids were considered to be normal in structure and function; weakness of the orbicularis, apparent in the upper lid, was not noted in either lower lid.



Fig. 1 (Potter). Bilateral congenital coloboma of the upper lids.

The conjunctiva of the right eye was injected and hyperplastic in the nasal portion, especially in the region of the upper nasal limbal area. The nasal half of the cornea was cloudy; in the central portion of this nebulous area a dense opacification was present which stained slightly with fluorescein. From this central scarred area a band of vascularized conjunctiva extended upward and nasally. The conjunctiva of the left eye was neither thickened nor unduly injected. Corneal abrasion and ulceration were absent in this eye; scarring consisted of a relatively thin corneal cloud located in the inferior nasal portion of the cornea. No pannus was present in this eye.

In both eyes relatively satisfactory examination of the anterior chamber was accomplished; in neither were the signs of previous or present iritis noted.

The lens, the vitreous, and the fundus were negative on ophthalmoscopic examination, with the exception of the finding of three diopters of myopia, each eye.

Extraocular movements could not be satisfactorily determined; no motor paralysis nor gross motor anomaly was present, although it was noted that nystagmus of horizontal-fixation type was present in all ocular positions.

Visual acuity could not be determined; retinoscopy revealed three diopters of myopia.

### DISCUSSION

*Surgical correction* of the defect described was accomplished by freeing the lateral palpebral ligament; tissue in the zygomatic region was undermined and the flap formed of the lateral portion of the lid united with the nasal flap. Postoperative cosmetic result was very satisfactory; healing of the corneal ulcer of the right eye was prompt. Position of the upper lids and lid motility following surgical correction were satisfactory.

In a description of the development of the eyelids Ida Mann<sup>1</sup> quotes from Prof. J. E. Fraser, stating that at the beginning of the second month the maxillary process, lying below the eye on each side, extends forward as far as the opening of the nasal pit, coming there into contact with the inner and outer nasal folds which form the boundaries of the opening. The maxillary process thus lies in contact, along the whole of its upper border, with the paraxial mesoderm encircling the eye and the primitive nose. The eye is embedded in this paraxial mesoderm. A projection below the eye, forming a shelf-like lower lid, is present at the 16-mm. stage. At this time a new epithelium-covered fold appears between the mesodermal brain fold and the eye. Growing downward this process produces a true lid, which begins to overlap the eye from above. In the 18-mm. embryo the upper lid has extended forward and backward to meet the developing lower lid and thus form the outer canthus. A new formation,

developing from the mesoderm above, extends downward between the eye and the groove separating the nose and the brain. This process is formed of two portions, the first of which extends to the groove of the brain and the nose; the second grows down in front of the projecting eye, overlapping the underlying structures, and meeting the upper end of the maxillary growth in this region. During the ensuing period of growth elongation of the lids occurs, with the result that they gradually cover the projecting eye and meet over it. The growth is apparently more rapid toward the inner end, so that the lids begin to close from within outward at about the 32-mm. stage. As the margins meet, ectodermal fusion (adhesion) takes place between them. Fusion is complete at the 37-mm. stage and persists until shortly before birth. The formation of glands in the lids takes place while they are fused, and it is only after these formations are completed that cornification of the superficial cells in each lid margin leads to separation of the lids.

Colobomata of the upper eyelid, according to Ida Mann,<sup>2</sup> are characterized by a most usual occurrence at the junction of the inner and middle third of the upper lid. Typically, lashes and glandular structures are absent from the lid margin, and distribution of the defect is unilateral. Further developmental anomalies of the face are frequently noted, together with the appearance of dermoid growths of the canthus.

In explanation of the probable developmental etiology of this type of defect Ida Mann has commented that clefts are never observed in normal lids, nor is the lid ever noted to be adherent to the eye, and for this reason colobomatous-type defects cannot be classified as germinal in origin or as being due to localized arrest in growth. Evidence of inflammatory proc-

ess is invariably absent. It is noted that the majority have every appearance of being malformations depending upon some factor of mechanical character. The view of Seefelder is quoted by Ida Mann; the suggestion is made that in the occurrence of triangular lid defection there has been a failure of adhesion of the upper-lid and the lower-lid folds, or a premature breaking down of the adhesion. Differentiation of lashes and lid-margin structures occurs only during the period of adhesion,

and failure of such structures to develop correlates well with the suspected failure of the lid-margin adhesion to occur. The gap itself is described as a lag in growth, possibly due to the absence of the pull of the adhesion. The older theory that notches in the lids are the remains of the facial cleft is untenable, first, because the facial cleft does not involve the eyelids, and, second, because two defects are frequently noted in one lid.

*816 Strand.*

#### REFERENCES

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- <sup>2</sup> ———. Developmental anomalies of the eye. Cambridge University Press, 1937.

### WATER BATH FOR MAINTAINING PROPER TEMPERATURE OF EYE-IRRIGATION SOLUTIONS

WENDELL L. HUGHES, M.D.  
*Hempstead, New York*

A warmer to keep a small amount of stock irrigating solution warm for treatment purposes renders irrigation of the eyes so consistently pleasing to the patient, because the temperature is exactly right at all times, that it is well worth the initial cost. The author has had two such pieces of apparatus in service for 6 and 15 years, respectively. The apparatus is so troublefree and satisfactory that it was thought worthwhile to describe it.

The essential part of the apparatus is a thermostatically controlled water bath, two types of which can be used, and a rack to hold the bottles.

1. A water bath, such as the one illustrated\* (figs. 1 and 2), measuring 4½" by 9" by 4" deep (inside dimensions)

\* Obtainable from Eimer and Amend, 633 Greenwich Street, New York, New York.

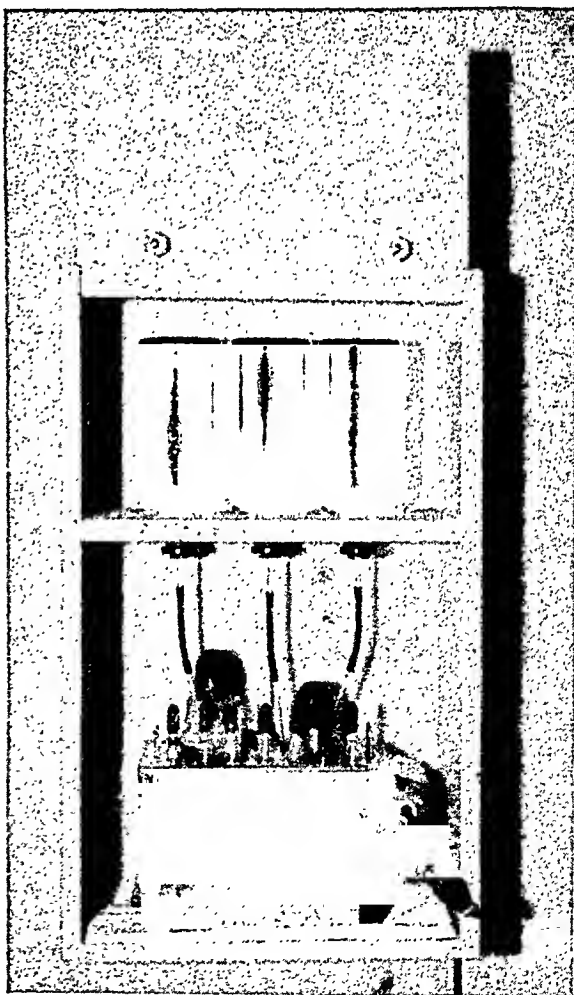


Fig. 1 (Hughes). Photograph of apparatus.

has a built-in thermostat and heating element. A finsmith can make a stand to hold Ziegler jars and six or seven small dropper bottles so that they will be two thirds immersed.

The rack (fig. 3) used by the author has 11 holes in the top layer, which fits flush

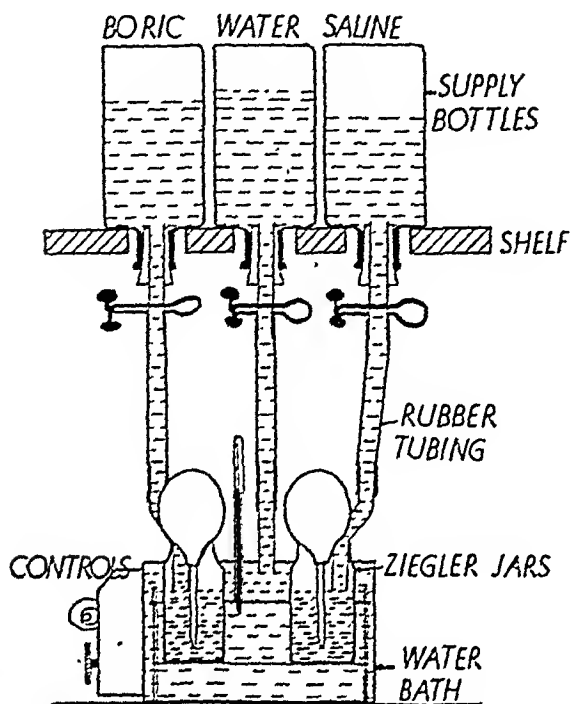


Fig. 2 (Hughes). Diagram of apparatus.

with the level of the top of the water bath: (a) for Ziegler jars (3 inches across), two; (b) for two-dram dropper bottles ( $\frac{5}{8}$ " across) in front of the above mentioned openings, seven; (c) hole for a thermometer (small hole in shelf below to hold the thermometer off the bottom, one; (d) hole for the tube from the water-supply bottle above to keep the water in the bath at the proper level, one; (e) an extra hole or two for culture tubes is easily added.

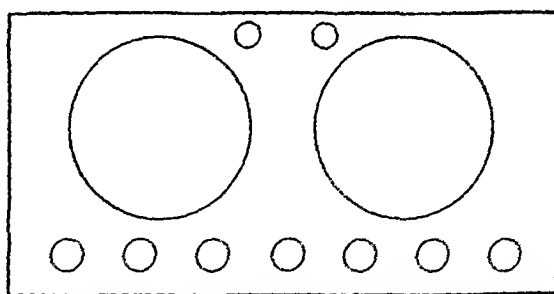
There are shelves below the top layer which are placed at different levels, one for the Ziegler jars and a second one with small holes placed under the holes for the dropper bottles so that they are held in the upright position. A second layer with

holes the same size as those in the top is placed midway between these two layers to keep the bottles from floating away when they are nearly empty.

2. A rack can be made to fit any dish deep enough to contain sufficient water partially to immerse two Ziegler jars, a thermometer, and a thermostatic switch with a heating element such as the type used to maintain proper temperature in a tropical-fish tank, obtainable from any tropical-fish supply store.

In either case the switch is adjusted to maintain a temperature of 40°C.

A shelf with three holes,  $1\frac{1}{2}$ " in diameter, 4" apart is placed above the water bath to hold three large 16-oz. supply bottles turned upside down (fig. 2). Through the cork of these bottles is passed a short piece of glass tubing and a second piece at the other end of a piece of rubber tubing. The glass and rubber tubing must be of sufficient diameter (0.25", 6 mm.) so the fluids will pass down and air will



PLAN OF HOLES FOR ZIEGLER JARS AND DROPPER BOTTLES

Fig. 3 (Hughes). Diagram of rack for holding bottles and Ziegler jars.

be admitted to the bottles through the same tube. These are made sufficiently long so the fluid in the Ziegler jars and in the water bath will be maintained at the desired level. If desired, a two-holed stopper and two tubes may be used from the supply bottles, passing down to the solution jars in the water bath, in which case the rubber and glass tubing may be of smaller diameter. One of these tubes

will go to the top of the solution in the supply bottle when it is inverted, to let air in when the fluid level in the jar below permits, and the other just passes through the stopper. It goes to the bottom of the fluid in the jar. A spring clamp on the rubber tube is used to prevent spilling the fluid when changing the supply bottles. It is stored on the glass section near the supply-bottle stopper when in use so that it does not obstruct the automatic flow of the fluid.

With either of these arrangements the

fluid in the jar is automatically replenished from the supply bottle above, as it is used for irrigating the eye. The supply bottle above is large enough to hold a supply for several days, and the reserve amount may be seen at a glance. The water in the bath is kept at the proper level in the same manner.

It is the hope of the author that this apparatus will be found sufficiently useful to warrant this report.

*131 Fulton Avenue.*

## SOCIETY PROCEEDINGS

EDITED BY DR. RALPH H. MILLER

### COLORADO OPHTHALMOLOGICAL SOCIETY

March 9, 1942

DR. WILLIAM H. CRISP, *presiding*

#### SOME NOTES ON OPHTHALMIC BACTERIOLOGY

DR. RICHARD THOMPSON, Professor of Bacteriology at the University of Colorado, spoke on this subject.

#### UNUSUAL LESION IN THE MACULA

DR. WILLIAM BANE presented the case of a Negress, Mrs. W., aged 38 years, who gave a history of poor vision in the right eye for the past several years. There was no history of injury. She suffered no pain nor discomfort. She had worn glasses for the past seven years and the last change of lenses was made in 1930. She complained of being able to see only one letter at a time with the right eye. The vision without glasses was R.E. 20/40, L.E. 20/20. The pupils reacted normally to light and accommodation. The tension was 20 mm. Hg (Schiotz) in each eye. Ophthalmoscopic examination revealed

deep cupping of the optic nerves and a mottling of the macula in the right eye. The vessels passed through the scleral rim of the optic nerve as they entered and left the eye. Remainder of the examination was negative. Central fields of vision were normal for the left eye, but in the right eye a horizontal scotoma was found. The scotoma included the blind spot and extended 20 degrees to the nasal side of the vertical plane and 15 degrees below the horizontal plane. Refraction improved the vision in the right eye to 20/20, one letter at a time; and the left eye to 20/15.

#### BUPHTHALMOS

DR. RALPH DANIELSON presented the case of L. N., a boy, aged 15 years. History revealed that his birth was normal, full term. He had had the usual childhood diseases, all of these after the onset of the eye trouble. There was no family history of eye trouble. When the patient was 3½ months old, his mother noticed that the pupil of the right eye was covered with a white film, followed by the same condition in the left eye one week later. It was at this time that medical advice was

sought. On November 5, 1927, under a general anesthetic the tension in each eye measured 50 mm. Hg (Schiötz) and was not improved by the use of miotics. In February, 1928, a bilateral iridencleisis was performed. The vision in November, 1928, sufficed to see large objects, unimproved with lenses. In May, 1931, the pupil of the left eye was yellow and the eye had become soft. Enucleation of the left eye was done in July, 1931, and a gold sphere was implanted which came out a year later. The tension of the right eye remained from 35 mm. to 45 mm. Hg (Schiötz) even under miotics. The general health of the patient had remained good until 1941 when he developed spinal trouble. X-ray studies revealed a tuberculous condition which was no longer in a progressive stage. This case of buphthalmos was presented to determine the advisability of surgery.

#### RETINITIS PIGMENTOSA

DR. HENRY LIEBENBERG presented the case of L. C., a man, aged 51 years, who was seen in the clinic in October, 1938. He gave a history of poor vision and night blindness with gradual progression since childhood. There had been similar blindness in five generations of the family. The vision in each eye was less than 2/200. External examination of the eyes was negative. The lenses showed anterior polar and posterior cortical opacities. Fundus examination revealed peripheral pigmentary deposits, bone corpuscular in shape. The patient was seen again in February, 1940. He had had a cataract extraction of the right eye and the vision was improved to 10/200. The fields of vision taken at this time showed a general constriction to about one half the normal size. The rest of the examination showed the same findings as previously. The patient was seen again in March, 1942, with no further change in his condition.

#### A CASE OF MULTIPLE EXTERNAL LESIONS

DR. JOSEPH TSCHETTER presented the case of J. W., a man, aged 70 years, who complained of lacrimation and redness of the eyes. Vision was 20/15, each eye, without correction. Tension was 15 mm. Hg (Schiötz) each eye. Examination revealed a senile ectropion, each eye, with eversion of the lower puncta and hypertrophy of the conjunctiva. A chalazion was present in the upper lid of the right eye near the outer canthus. Small pterygia were present at the nasal limbus of the cornea in each eye. Ophthalmoscopic examination revealed large floaters in the vitreous and retinal arteriosclerosis. This case was presented for the multiple external conditions present and their order of treatment.

Harry W. Shankel,  
*Secretary.*

#### NEW YORK SOCIETY FOR CLINICAL OPHTHALMOLOGY

April 6, 1942

DR. JAMES W. SMITH, *presiding*

#### SYMPOSIUM ON INDUSTRIAL OPHTHALMOLOGY IN WAR EFFORT

#### SUGGESTIONS ON FIRST-AID IN EYE IN- JURIES—A MEASURE OF CIVILIAN DE- FENSE

DR. PERCY FRIDENBERG stated that first-aid is not treatment. It consists essentially in relief of pain, protection of injured parts, prevention of infection, and immediate transfer of injured to bases where appropriate medical or surgical procedures can be instituted. This is of prime importance in eye-injury cases. Foreign bodies, burns, and wounds of the conjunctiva, cornea, and lids will be the usual traumatisms. Irrigation, flushing out the conjunctiva, instillation of



butyn or novocaine, a sterile dressing will suffice, temporarily. Records should be kept and identification tags attached to the patient. The first-aid kit of the "ambulant" aider needs only a few things for the aforementioned procedures. Posts and stations will, of course, require more; for example, sterile solutions, towels, instruments, a good heat and light source, a good nurse.

#### A MORE REALISTIC OPHTHALMIC SERVICE IN INDUSTRY

DR. ALBERT C. SNELL stated that the need for a more realistic ophthalmic service in industry originates from the three following situations: First, the demands made on vision by modern industry; second, the need to employ such degrees and qualities of vision as employees possess and can use effectively; third, the need for adequate ophthalmic service. Increased production means increased demands on vision. Correction of visual defects, which are found to average about 15 percent among industrial employees, is necessary to increase visual efficiency. After correction, efficiency has been found to increase production by 5 percent.

Many visual defects cannot be corrected to bring about perfect visual function. There are probably 400,000 employees in this class.

There is need for a more realistic ophthalmic service; first, protective; second, new technique in discovering visual defects; and, third, a more convenient method of examining and supplying proper treatment or correcting lenses. There should be more well-balanced medical staffs in industry. Such staffs should include an ophthalmologist, either part-time or as consultant.

The responsibility for a more adequate ophthalmic service rests with management, labor, and medical staffs (includ-

ing a coöperating ophthalmologist). All these groups have a responsibility in any program of detection, protection, and correction of the vision of industrial employees.

*Discussion.* Dr. Elbert S. Sherman said that there was a great laxity in the prevention of eye injuries. Many plants have no compulsory rules concerning the wearing of goggles, and in many it is not enforced. He agreed that 90 percent of eye injuries that come to the office as a result of accidents could be prevented by the wearing of goggles. There is a great need for more strict regulations in small plants and also, in many instances, in large plants. He cited the case of a man who was struck by a "slug" of steel. It penetrated the cornea, tore the iris, injured the lens, and entered the vitreous. It was removed without difficulty. The eye was saved but there was very little vision. Before the man went back to work he was asked if he was not required to wear goggles and he replied "nothing ever happens." This man wore goggles when he returned to work.

Dr. Sherman endorsed Dr. Snell's very practical definition of "good vision" which is "that degree of visual functional ability which is adequate for the performance of the visual task presented." This should be printed in large type, framed, and hung in the office of every employment manager. The common unreasoning practice of adhering to an arbitrary, inflexible standard of visual acuity, without consideration of other factors, for all applicants for employment is unfair to both the employer and the prospective employee. It may fail to reveal other, possibly serious, visual defects, and, on the other hand, the employer is often deprived of the services of a worker well qualified for many types of employment. Fortunately the defect, in many cases, can be remedied

with glasses or by other means. Many cannot be helped.

Particularly distressing is the plight of the young person (there are thousands of them) with congenital amblyopia, who has just applied for his first job and been rejected. He is able and eager to work and comes to the ophthalmologist for help and finds that he is up against a stone wall. At his age not much can be done for an amblyopic eye. These cases emphasize the need for more pre-school examinations of eyes. Most of these cases when discovered early in life can be helped.

How to deal with the problem presented by these and other one-eyed individuals is an important question. The legislative method suggested by Dr. Snell sounds practical and should be followed up. In New Jersey the liability of an employer of a one-eyed worker who loses his remaining eye is limited to compensation for the loss of one eye. Further compensation for the resulting total permanent disability is taken care of by a revolving fund made up of assessments on insurance carriers and self-insured employers, and administered by the Labor Bureau. In spite of this, employers are very reluctant to employ a one-eyed man. This is a very important social and economic problem. Experience has shown that the individual who has always had only one useful eye is as efficient in many types of work as one with binocular vision.

It would seem that Dr. Snell puts too large a share of the responsibility for an inadequate ophthalmic service in industry on the ophthalmologist. No progress can be made until industrial managers are educated to realize the need and value of such service. This will be a slow process. It has taken many years of educational effort by the National Society for the Prevention of Blindness, the National Safety Council, and other agencies and

individuals to bring about partially effective action for the prevention of eye accidents. Many managers, especially in small plants, are still in the kindergarten. One sight-saving rule most of them have learned, often by expensive experience; that is, the importance of prompt treatment of an injured eye by an ophthalmologist.

Dr. Snell, in closing, said that the A.M.A. has a Council on Industrial Health which is very active and welcomes suggestions. It hopes to bridge the gap between the need for service and the man who can give it. He said that there was a great need for adequate medical staffs. There is no instance in which such a staff has not proved its worth, and this would have to be pointed out to management.

#### THE PROBLEM OF FAULTY STEREOPSIS IN INDUSTRY (A PRELIMINARY REPORT OF CERTAIN OPERATIONS IN THE PUBLISHING FIELD)

DR. LAURANCE D. REDWAY stated that employees who handle and file metal stencils by the millions are often inaccurate in their work and must daily read intaglio characters on the back side of these "metal mirrors." They are subject to eye fatigue and nervous symptoms of a vague character. Many of them are women, frequently absent from work because of headache and "nervous upsets." The stencils because of the zero contrast of the depressed characters, and the brightness of the metal, presented a problem which has been mechanically solved by filling the depressed characters with black quick-drying ink. Satisfactory contrast has been achieved.

A survey of illumination found this inadequate. Experiment with fluorescent lighting of an intensity of 65 foot-candles proved to be nonfatiguing and is psychologically acceptable. Errors in filing continued to occur, however, although headaches, eye strain, and "nervous up-

sets" seem to have decreased.

Employees were examined for visual defects, muscle imbalance, and faulty stereopsis. About 2 percent were found to have complete absence of this function in a group of 281 examined. Found deficient in some degree were 19.2 percent.

Stencil filing requires a high degree of accuracy of vision, binocular function, depth perception together with rapid ocular and manual coöperation and equilibration. The operation is almost ideal for the study of the effect of faulty stereopsis or the absence thereof as an occupational handicap-hazard. Further studies under rigidly controlled conditions are contemplated.

Respecting faulty stereopsis, if 25,000,000 people are employed in industry, and if 2 percent may reasonably and conservatively be said to have deficient depth perception, it would be a characteristic of some 500,000 persons. Such a large group deserves further study to determine the relationship of the handicap hazard of faulty stereopsis to specific high-speed operations in industry in its causal relation to accidents, errors, and nervous disorders.

*Discussion.* Dr. Morris Davidson said that industrial ophthalmology is not concerned solely with the treatment of eye injuries. The relationship between the job that is being done and the bigger job should be borne in mind. There are about 4,000 injuries annually in New York City. This number is likely to be doubled or tripled by the end of this year. The ophthalmologists must be prepared not only to handle these increased cases but also to help prevent them, and to supply eye care that is badly needed. He suggested that when handling eye injuries, there is no reason why a prescription for glasses should not be given to the patient if necessary. The refraction has already been done in the course of examination.

As to stereopsis, he believed it at least

second in importance to visual acuity. He might even say it is equally important. Twenty percent of the people have defective vision—of course not all serious, not correctible by glasses, in accordance with a survey, in 1939, of the eye material examined for compensation purposes—and 2½ percent of the whole population suffer from a lack of stereopsis. Obviously, stereopsis is a very important item in any eye examination. It is necessary to get away from the feeling that it is important only in squinters and orthoptic training. It is important in many other cases. It is often absent in high anisometropia, minor ophthalmoplegia, and heterophoria. He has seen it absent after operation for detached retina, in blepharospasm—whether it was the cause or effect, he did not know—and in aniseikonia. Dr. Redway's figure of 2½ percent of his material with an absence of stereopsis coincided with his own findings in his 1939 survey and is probably the correct figure. Probably 10 percent more have faulty stereopsis. In cases of minor squint it is sometimes lacking in near vision and not in distance or vice versa. This cannot be determined unless the examination is made for distance and near. As to the instruments, stereopsis can be just as accurately measured as visual acuity. Until World War I there was little concern about it because man was largely a terrestrial animal. Since the extension of aviation, however, a great deal of work has been done and devices suggested by Howard, Dolman, by Pulfrich, who brought out stereoscopic cards, by Martin Cohen, by Conrad Berens, and by the speaker. It does not matter much what instrument is used, but the examination for stereopsis should be made a routine part of the examination in every eye case.

Dr. Ralph I. Lloyd said it was the first time at an eye meeting that he had heard reference to the fact that a patient does

not necessarily use both eyes for both distance and near. He became interested in this question many years ago and found that 20 percent of a group of 300 office workers did not have binocular vision for both distance and near. The determination of this function for both near and far should be a part of every eye examination.

Dr. Ernst L. Metzger stated that for many mechanical jobs binocular vision and stereopsis should be tested not only in the examination room but also at the place where the work is actually performed. It was very revealing to see how the working conditions improve with the elimination of glare and the proper intensity and wave length of the illumination. The advantage of the fluorescent light, for instance, is obvious in Dr. Redway's cases, where the objects were stationary. Where we deal with moving objects the stroboscopic effect may cause serious trouble and lead to early fatigue. The color of the illumination is important because the chromatic aberration of the human eye affects the accommodation, the convergence, and the following of fast-moving objects with the eyes far more than one generally expects. The colors of short wave lengths are focused in the emmetropic eye in front of the retina, whereas the red end of the spectrum is focused behind it. The resting emmetropic eye is focused for parallel beams of the yellow region of the spectral band. In mixed (white) light the chromatic aberration is an error only in a physical optical sense; biologically it must be considered as a valuable aid for the accommodation and stereoscopic vision. The influence of colors upon posture and muscle tonus—not only of the eye muscles—which has been established in laboratory experiments, could easily be utilized in the selection of adequate illumination for special technical requirements.

The ability to see stereoscopically is not constant even with the same individual. It changes considerably within the duration of one working day. It may improve during the first few hours on account of training and certainly will decline or even get lost in some people toward the end of the day on account of fatigue.

These are only a few of the numerous factors requiring careful consideration in ophthalmologic job analysis. They may help to find a more biologic basis for the relation of working time and relaxation in peace time and war industry.

Dr. James W. Smith asked Dr. Davidson to explain how the scheduled loss is computed in workmen's compensation cases when stereopsis is impaired following eye or head injuries.

Dr. Davidson said the compensation is computed on the basis of the result of examination of the motor field. Only that part of the field which is lost is compensated for. Total absence of stereopsis is equivalent to loss of an eye. If there is an ophthalmoplegia of one elevator, there is a loss of stereopsis only in the field of that muscle. The lower half of the field is considered of greater importance than the upper, and compensation for its loss is twice that of the loss of the upper field.

Dr. Laurance D. Redway in closing said that fluorescent light contained a high percentage of blue, which would fulfill the requirements of which Dr. Metzger spoke.

He said that the laxity in prevention of accidents was not always on the part of management. In a few plants where the lighting was admittedly bad, if a doctor came into the plant with instruments or made suggestions, he engendered suspicion on the part of the employees. They were suspicious of what he was doing and considered him the agent of the management. In such instances the work had

to be done in a more circuitous way.

As far as he knew, no other investigations in connection with metal stencils had been done. He would be glad to hear of them, if they had.

#### INDUSTRIAL OPHTHALMOLOGY FROM THE STANDPOINT OF INDUSTRIAL HYGIENE

DR. LEONARD GREENBURG stated that from the public-health viewpoint, there are essentially five elements in the program for eyesight conservation. These are: 1. Preventive medical care. Greater emphasis is needed here especially in the prevention of syphilis, glaucoma, and other diseases which directly and indirectly contribute to blindness. 2. More eye examinations. These should begin at a younger age than at present and continue past middle life at frequent intervals. In addition, the necessary medical and refractive care which these examinations disclose should be given. 3. Better seeing conditions. Many work throughout life under conditions of artificial illumination not conducive to the preservation of eyesight. There must be a continuing campaign for more adequate and satisfactory illumination in the home, workshop, at play. 4. Control of accidental eye injuries. The campaign for the control of accidental eye injuries has hardly been touched in this country. In the home, at play, and in industry it is imperative that blindness be prevented on a wide scale. 5. Mass educational program. Over and above the aforementioned four elements in the picture there is required a mass educational program from pre-school to late adult life, covering all phases of the problem. Dr. Greenburg made a plea for a designed program along these lines.

*Discussion.* Mrs. Eleanor Brown Merrill, Executive Director of the National Society for the Prevention of Blindness, emphasized the need for more complete statistical data. Responsibility for pre-

vention rests with management, labor, medical, nursing, and safety personnel, and with the employees.

Mrs. Merrill referred to the survey of a group of 34 concerns, mentioned by Dr. Snell. Eye safety was found to be given relatively little attention. Few provided for examining the eyes of employees or took into account the part which "seeing" conditions might play in relation to every type of accident. Following this survey, the National Society for the Prevention of Blindness is extending its educational program in this field. The sale of Louis Resnick's book, "Eye hazards in industry," is being promoted; from it a brief digest has been prepared for distribution to safety engineers in training under the auspices of the National Committee for the Conservation of Manpower in War Industries; a primer is in preparation for management because the responsibility rests largely with management, which must be shown the need and the opportunity for safe and economic practice.

During recent months there has been an increase in industrial accidents, and further increases may be expected under pressure of the growing production program. According to the American Social Hygiene Association, there has been an increase of venereal disease in industrial areas, and those concerned with prevention of blindness realize the significance of this to ocular health. The Association has studies under way in a Kentucky mining area and in a California aircraft-production area which should provide material of value for education of workers, their families, and the general public. In this connection it is worth noting that one large company in another state has asked the assistance of the National Society for the Prevention of Blindness in preparing a pamphlet for distribution to its workers, which will not only discuss industrial safety but will include

information on eye care in the home and at various age levels. Thus the family can be educated through the industrial approach. Many similar moves could be taken.

In closing, Mrs. Merrill referred to a poster she had recently seen carrying the slogan, "Every accident is a blow to safety." The educational program should emphasize the fact that time lost in accidents means slowing up of defense activities, as well as added danger and general decrease in efficiency.

Miss Grace S. Harper, Director, New York State Department of Social Welfare for the Blind, pointed out that under the educational laws records of eye tests and eye examinations should be available at the time that students leave the public schools, including vocational, trade, and technical schools. She said that if the educational laws were more adequately carried out, much of the information needed should be transferable to industrial management. Also that for younger applicants for employment the work permits issued by the Department of Education must include a description of the physical disability of the minor and state the specific occupations in which the minor may engage.

Dr. Percy Fridenberg said that the spoken word was better than the pamphlet and suggested that the educational program for the prevention of eye injuries might be aided if all the first-aid teachers, who have contact with many people, were instructed to speak for a few moments on this subject, pointing out that first aid is the last step and not the first. They could stress the need for periodic eye examinations and the prevention of accidents in the home.

Dr. Adolf Posner emphasized the points made by Dr. Snell; namely, that the man should be fit for the job and the importance of the examination. He cited

two cases. The first case was that of a man, 60 years of age, who for many years had worked in a boat yard which he owned. He wanted to get a job in another boat yard. He had incipient cataract with vision of 20/70. He was required to have 20/40. The foreman was particularly anxious to hire him as he was well qualified for the job. The central part of the lens was clear. Pilocarpine was given. He passed the visual test and now both he and the foreman are happy. The second case was that of a patient with keratoconus, with 20/400 as the best corrected vision. Ten years ago a New York oculist gave him the old spherical Zeiss contact lenses. He has not been able to wear them but he puts them on for the civil service examination. He has taken 24 examinations and passed all of them.

Dr. Leonard Greenburg was very much interested in Miss Harper's suggestion and felt that it should be followed and receive full consideration. The educational program, he pointed out, is a very large task in itself. Much has been done in the preventive field, but much more remains to be done. Many companies, the outstanding one being the Pullman Car & Manufacturing Company, have very few eye accidents, but there are many others which should employ the compulsory-goggle program.

He was interested in Dr. Posner's cases and cited one of a highly skilled gear shaper who was offered another and better job in a war industry at a salary of approximately \$125.00 a week. He failed to pass the eye examination because of defective vision in one eye and in spite of the fact that he had been at the same job and had been successful for many years the plant doctor would not employ him because of his visual defect.

Sidney A. Fox,  
Secretary.

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## THE WAGNER BILL

Perhaps by the time that this number of the Journal goes to press action will have been taken on Senate Bill No. S1161, known as the Wagner Bill, now before Congress. It may not, however, be too late to make editorial comment about it.

In this issue there are two articles that deal with subjects directly related to those covered in the Wagner Bill; namely, the editorial on "Communitistic rumblings" and the review of De Kruif's book, "Kaiser wakes the doctors." In brief, this bill proposes placing in the hands of one man—the Surgeon General of the Public Health Service—the power and au-

thority (1) to hire doctors—possibly all doctors—at fixed salaries to provide medical service; (2) To designate which doctors can be specialists; (3) To determine the number of individuals for whom any physician may provide service; (4) To determine arbitrarily what hospitals or clinics may provide service for patients. It instructs the Surgeon General to provide general and special medical care, laboratory tests, and hospitalization for all beneficiaries of the Social Security Act and their dependents—estimated at 110,000,000 people. This bill also provides for placing in the hands of the Surgeon General of Public Health Service three billion dollars to meet the expense of this



medical care. Space will not permit details of the plan, but it must be obvious that, if passed, the medical care of the people of America will for the most part be under Federal direction.

The methods of handling the health of our people have been under fire for many years; perhaps at no time more than at present. Even the most ardent advocate of the current system must admit that it often falls far short of giving maximum medical care to a certain section of the people.

It is perhaps an unfortunate fact that the rapid growth of America has tended to exalt the value of money often to the disparagement of finer things. Every man wants to have for himself and to provide for his dependents the best in schooling, housing, food, and clothing that can be had. His success in life is too generally measured by the appearance that his physical properties present. The physician has not been unaffected by this trend—probably the altruism of our fathers has been somewhat dimmed in us by this change; we tend to forget that the fundamental purpose of the healing art is the helping of others. The medical care that is best for the people and not necessarily the most remunerative for the physician is that which he must sponsor.

The income tax with all its disagreeable features may prove the leavener; it is now, and in our generation and probably that of our children will continue to be, impossible to keep for oneself anything above a modest income. This may in the *long run* prove helpful to medical practice. It may cause the physician to be more willing to direct his activities into the less remunerative channels; it may divert his interest from rich patients—in the first place, there will not be rich patients, and, in the second place, no matter how large an income he might derive

from them he would not be able to retain it.

However, regardless of what change shall be made in the administration of medical care, one thing is certain, and that is that to have this completely under the control of the Government, with the physician having no voice in it, will not be of the greatest advantage to the patient and will surely work a serious detriment to the physician. Doctors must agree on this point no matter how much they may disagree on other phases of the people's care. Undoubtedly in the immediate future the doctors of America must actively and personally take action on the economics of medical care, or the matter will be taken out of their hands. If they continue to leave this to a few representatives who may not truly represent their thoughts, Government or State control appears inevitable. The action that must be taken *now* is to write to your representatives in Congress that you regard the Wagner Bill as pernicious and urge them to vote against it.

Lawrence T. Post.

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### COMMUNISTIC RUMBLINGS

In the development of social and political reorganization few will dispute that evolution is distinctly to be preferred to revolution. Not infrequently, reform measures are found to have been adopted without adequate understanding as to the results which might be expected. Mistakes have to be corrected in the light of experience. The sum total of human happiness and efficiency is likely to be greater, and the shocks and disasters arising from misjudgment may be expected to be less formidable, if change proceeds gradually than if it occurs with explosive and overwhelming force.

Yet revolutions, more or less violent



and explosive in character, are often rendered inevitable by the obstinate and misguided resistance of vested interests to the pent-up forces of progress. Unfortunately, sweeping change sometimes does as much harm as good, at least for the time being, even though the final accounting may show gain rather than loss. False steps made on a heroic scale may be later corrected, but in the meantime great harm may have been done to large sections of the population, or even to the social and economic structure.

In the name of freedom and justice, the forces unleashed by the French Revolution perpetrated much that was unjust and tyrannical. History will probably make the same criticism of the Communist revolution in Russia. Happily, the Russian movement can take credit for many contributions to progress, not merely in Russia, but throughout the world.

Sociologically speaking, the rank of any nation in the scale of development may be estimated according to the educational condition of its population. General progress is impossible in the presence of wide-spread illiteracy. A printing press accessible to every citizen will go far to make stagnation impossible.

The development of medical knowledge and the efficiency of medical care are also broadly parallel with the educational status of the people. Among the world's most important masses of population, India and China still show a grievous preponderance of illiteracy. In each of these two countries the great majority of the inhabitants are practically without medical care, except so far as it is provided through the traditional knowledge and skill of the primitive citizen.

Twenty-five years ago, the Soviet Socialist Republic, heir to the weaknesses of the Czarist régime, had a population of whom 70 percent were illiterate. At that

time, Russia had something like 24,000 physicians. Shortly before Hitler's invasion of Russia, the number of physicians in that country was put at 170,000,\* and we are told that in the present war this body of fully trained physicians is supplemented by 500,000 so-called "Feldshers" (a sort of surgical helper), less completely trained in medicine, and about one half of whom are women. In the same period, partially through adult education, the percentage of illiterates among the Russian population has been reduced to less than ten.

In backward countries, it is obvious that retardation as to elementary education, and inefficiency in regard to the provision of medical service, could hardly be overcome in a short period without bureaucratic interference. The slow processes of natural development, alike as to literacy and as regards provision and acceptance of medical care, would have been quite inadequate to bring the Soviet Socialist Republic to its present relatively high level in both relationships. In the large centers of population the Russian government has found it necessary to establish a type of medical organization such as would be viewed with alarm by the physicians of the United States.

Although a certain amount of private practice is permitted, we are told that almost all Russian physicians are employed by the Soviet government. The greatest emphasis is laid upon preventive medicine and hygiene, and the care of mother and child. There are many rest homes and sanatoria for Russian soldiers and workers and their families, a number of these structures having formerly been palaces belonging to the royalty and nobility. We are assured that medical stand-

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\* A recent article by Rubenstein (*California and Western Medicine*, 1943, July) puts the number of physicians at 200,000.

ards have been improved during and in spite of the war. When the capture of Moscow was threatened by the Germans, medical students and teachers were evacuated to the rear, along with other scientific and educational organizations.

Another interesting example of governmental intervention concerning medical service in a medically backward country is to be found in Mexico (see Michael Scully, *Pan-American Magazine*, 1943, February). In the year 1936 a survey disclosed that of Mexico's seventeen or eighteen million inhabitants twelve million were without any sort of modern medical care. The conclusion was reached that Mexico needed 18,000 physicians, whereas it had only 4,500, 90 percent of whom practiced in the larger cities.

Under the guidance of Gustavo Baz, Dean of the Faculty of Medicine of the National University, vigorous measures were initiated. In the first place, 260 senior students of the medical department were made "provisionally" Doctors of Medicine, and were given (during their vacation period) the task of introducing the indispensable rudiments of public health, that of teaching hygiene, and that of collecting facts and statistics concerning life in the rural areas.

One of these enthusiastic young undergraduates was killed by superstitious Indians who had refused to accept his modern treatment of a case of diphtheria. Eleven were attacked by Indians but escaped serious harm. In several instances, troops had to be sent for protection of physicians and nurses.

The valuable information obtained through these youthful missionaries of *Æsculapius* resulted in an important further step. It was believed necessary to provide ultimately 12,000 more physicians for the care of new regional hospitals and ambulatory services. In 1937, therefore, President Cardenas approved a new

plan. Each year, an important number of the best graduates of the preliminary scientific course are enrolled in the newly inaugurated School of Rural Medicine. The expenses of these students are borne by the state. After graduation from the School of Rural Medicine they must serve at least five years in the Rural Medical Service of Mexico. The course of training devotes special attention to tropical diseases, and includes obligatory studies in dentistry and veterinary medicine. It is hoped ultimately to draw a steadily increasing number of such students from the youth of the Indian villages, so that they may return to practice among their own people.

The physician of the United States is ordinarily an inveterate individualist, with a great fear and dislike of regimentation. He desires to serve the public in his particular way. He is not afraid to work, but he likes to preserve the feeling that he is his own master and can practice medicine when, where, and how he pleases, without state control. He frequently derides and despises what is known as contract practice.

Yet he has seen his activities more and more limited by municipal and privately endowed activity in the provision of medical facilities. When he becomes a part of such municipal or charitable undertakings he usually shows a somewhat surprising willingness to serve without pay, apparently feeling that only thus can he maintain on the one hand an adequate body of experience and on the other hand a sufficient reputation among the community. He is apt to flatter himself that these services are performed in a spirit of altruism. But he commonly harbors a more or less vague idea that he is reimbursed for such services by the scale of fees which he is able to levy from most of his private patients, and especially from the more prosperous among them.

There is a good deal of support, both in experience and in a knowledge of human nature, for the belief that medical care rendered by the physician as a state employee would prove less efficient than private practice. Few will deny that professional obligation to the individual patient affords the highest type of medical care. Many unpleasant details about the English panel system have been recorded, and even worse statements have been made regarding the German Krankenkassen.

Generally speaking, the population of the United States no doubt fares better as to medical care than any other population in the world, in spite of a recent statement that "the medical scientists of Russia are being given better opportunity to produce good work than in any other country . . . Their conditions of work are well nigh ideal." There is perhaps in this country less excuse than anywhere in the world for a system of state medicine, with its tendency to bureaucratic red tape and weakening of the sense of individual responsibility.

The provisions of the Wagner bill which deal with the organization of state medical care will no doubt be opposed to the bitter end by organized medicine, as well as by the drug manufacturers who have already taken a prominent part in the movement of opposition.

As a quick remedy for some of the sociological diseases of the past, a more or less communistic structure of society is bound to appeal to the reformers of India and China, and in some degree to those of Mexico. The conditions which exist in those retarded countries do not prevail here in any great degree. Yet we must not blind ourselves to the fact that even in the United States the provision of medical care is not uniformly all that could be desired. The coöperation of the profession in the organization of various

systems of group medical practice is at least a partial admission that improvement is possible.

The abolition of private practice in the United States is altogether unlikely. The greater the general prosperity in any country, the greater the tendency for at least a large part of the community to demand private medical care. But is it altogether reasonable to suppose that such further extension of state medicine as proves inevitable will be entirely bad, or necessarily more corrupt and inefficient than much that now occurs in private work among corresponding strata of the general population?

We are told that in Mexico something very like a missionary spirit of enthusiastic service has been shown by the young physicians who have been trained for work in the backward communities. Concerning Russia, similar statements are too frequent and too explicit to be altogether incredible. Thus, for example, Lipetz (*Postgraduate Medical Journal*, 1942, January) praises the teamwork between different specialists, and the friendly discussions between doctor and patient, in a polyclinic near Moscow. We are reminded that "the doctor's working day is spent in seeing patients and not in rushing about from nursing homes to hospitals or covering a large mileage through the busy streets of towns . . . In the Soviet Union each is a full-time worker in his institution." As to qualification, Lipetz found it high, judged by British standards of general practice, although judged by British hospital standards it was often less than would be expected from a hospital consultant in England.

Lipetz quotes an English informant as attributing such virtues as are possessed by the Russian medical system, especially in relation to scientific development, to "the fact that the supreme body in Soviet medicine, the Commissariat of

Health," is "largely composed of eminent practical clinicians and scientists." If, in spite of the organized opposition, a plan for state medical care is adopted by the national government of the United States, it should be administered by "eminent practical clinicians and scientists" and not by a group of lay bureaucrats whose pet theories may encourage the worst rather than the best possibilities of the relation between physician and patient.

W. H. Crisp.

## BOOK NOTICES

TRANSACTIONS, SECTION ON OPHTHALMOLOGY, AMERICAN MEDICAL ASSOCIATION, 1942. Clothbound, 372 pages, illustrated. Printed by the American Medical Association, Chicago, Ill.

This volume presents the 15 papers which were read at the meetings of the Section on Ophthalmology at the 93d annual session of the American Medical Association, held at Atlantic City, on June 8th to 12th. The chairman's address by Dr. Lawrence T. Post, "Lifelong care of the eyes," sketched briefly the highlights of preventive ophthalmology—prenatal, childhood, and adult. Of interest is the discussion of degenerative (senile) ocular diseases, in which a summation is made of possible dynamic approaches to this problem.

Dr. Lowell S. Selling reported on "The ophthalmologist's place in the prevention of traffic accidents," stressing the fact that visual acuity alone is not even a fairly accurate index of a person's ability to drive an automobile, and that color vision does not seem to be of prime importance in the matter of safe driving. "The removal of metallic foreign bodies from the eyeball and from the orbit" was considered by Dr. Edmund B. Spaeth,

with particular regard to procedures and instruments which are of considerable aid, and which are too little used in this type of surgery. Dr. Spaeth presented the various methods of using roentgenography to assist in localization and removal of foreign bodies, and this discussion was amplified by photographs and case histories. Included is a description of the use of air injection into Tenon's capsule, as an aid in localization, and of the proper use of the endoscope of Thorpe.

Drs. C. S. O'Brien and J. H. Allen, in "Ocular changes in young diabetic patients" presented an interesting, pithy summary of their study of 555 young diabetics, revealing the interesting fact that 4 percent of them showed diabetic retinopathy; and that 13.8 percent of 260 patients showed diabetic lens changes. Of great importance in this paper, as is brought out in the comment, is the fact that it seems to go a long way toward settling the question of whether or not there is such a pathologic entity as diabetic retinitis, since in most of these patients no other disease was found. The paper of Dr. James W. Smith, entitled "Ochronosis of the sclera and cornea complicating alkaptonuria," is an excellent elucidation of a metabolic disease little known to ophthalmologists. The thoroughness and clarity of this study of the literature, of the theories advanced to explain this metabolic disorder, and of the presentation of cases make interesting reading. The article is well illustrated and contains colored plates of the gross and slitlamp ocular findings. Drs. Joseph Tiffin and Hedwig S. Kuhn reported on "Color discrimination in industry," based on a survey of 7,000 industrial employees. The authors do not describe the color test used in their study.

Dr. Walter B. Lancaster made an interesting addition to the literature on aniseikonia with a paper entitled the "Na-

ture, scope, and significance of aniseikonia." The classification of types of aniseikonia, particularly the description of various normal forms, should aid many ophthalmologists in their understanding of this condition. Dr. Lancaster discussed the mechanisms by which abnormal aniseikonia is dealt with by the organism; he posed the very interesting question of how aniseikonia causes the symptoms of eyestrain. Dr. F. H. Verhoeff presented a "Simple quantitative test for acuity and reliability of binocular stereopsis." Directions for the construction of this device are included, and a system presented for the grading of acuity of stereopsis, based on the Snellen notation for visual acuity. The test is compared to the Howard-Dolman test for stereopsis. The abstract of the discussion of this paper presents several interesting views on the determination of binocular stereopsis.

Of the four papers that comprised the symposium on "Geriatrics," three are reproduced in this volume. They are: "Medical geriatrics" by Dr. George M. Piersol, "Neuropsychiatric geriatrics" by Dr. Henry W. Woltman, and "Aging process in eye and adnexa" by Dr. Conrad Berens. This last paper is a detailed consideration of senile changes—"normal"—of each of the ocular and orbital tissues, as well as pathologic senile changes in the retina, lens, and optic nerve. Glaucoma, malignancies, and cataract are discussed.

Dr. T. L. Terry presented "Fibroblastic overgrowth of persistent tunica vasculosa lentis in premature infants. IV. Etiologic factors." Here Dr. Terry speculates on the possible causes of this uncommon condition and suggests a theory based on the precocious increase in blood pressure before disappearance of the hyaloid artery. This would stimulate a fibroblastic overgrowth to support the hypertrophied

hyaloid system. Dr. J. Goldsmith contributed a detailed, carefully worked-out study of the "Dynamics of intracapsular cataract extraction." Using freshly enucleated cadaver eyes, a series of experiments was performed under slitlamp observation leading to the conclusions that Hanover's canal is an anatomic, closed space; that the hyaloid membrane has no zonular fibers in relation to it; that, in intracapsular extraction, tumbling coupled with external pressure over the scleral surface produced the most efficient and least traumatizing rupture of the zonule. This article is accompanied by numerous photographs.

Dr. Moacyr E. Alvaro, guest of the Section on Ophthalmology, presented "Effects other than anti-infectious of sulfonamide compounds on the eye." This paper summarizes the ocular complications of sulfonamide therapy reported in the literature, with special emphasis on transient myopia, the most commonly reported complication. Dr. Alvaro points out that there is some relation indicated between the amount of sulfonamide administered, the duration of the therapy, and the degree of myopia. The exact mechanism of the phenomenon is not yet known. Dr. Edward Steiren presented to the meeting a "Metal safety and glare goggle."

The numerous excellent papers included in this volume are in keeping with the high standards of the Section on Ophthalmology with regard to research and observation.

Benjamin Milder.

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#### KAISER WAKES THE DOCTORS.

By Paul de Kruif. Clothbound, 158 pages. New York, Harcourt, Brace and Company, 1943. Price, \$3.00.

This book is written in the usual dramatic style that the author has assumed in

order to catch the attention of the public. Such a method does not lend itself to a scientific portrayal of a subject, but the latter would not be read by the general public. De Kruif states that he has always been an enthusiastic admirer of physicians, but that after a careful study of the economics of prepaid medical care as illustrated in the hospitals established by Henry J. Kaiser in connection with his shipbuilding plants and earlier Grand Coulee Dam project, he has become convinced that this, contrary to the opinion of organized doctors, is a most desirable method of handling the problem of supplying adequate medical treatment to the middle-income patients, who cannot afford the best that medicine has to offer unless they are willing to accept charity.

In this book he describes in great detail the experience of Dr. Sidney Garfield with prepaid care, first among the men engaged in construction on the Arizona desert and later in the Kaiser projects. According to the author, this experiment was astonishingly successful not only in the care of the patients but also financially. Modern hospitals were built at great expense but were rendered free from debt in a miraculously short period of time, due only to the payment of from 5 to 7 cents per patient per day, which covered 60 percent of the expense, the money paid by interested insurance companies accounting for the remaining 40 percent. Not only were beautiful hospitals built but they were equipped in the most approved modern manner, even including air conditioning, and a very complete staff of young physicians was employed at excellent salaries.

According to the author, stout objection to these projects was registered by organized medicine and by many of the local physicians, but the essential value of the projects and the efficiency of their

management were such as to overcome all objections.

The author admits that this ideal handling of medical needs cannot be accomplished everywhere in the United States without modification for the local conditions. He urges that it be directed by physicians themselves and not by the central government. He is convinced that it should be and will be the best method of administering medical care in the future for those who cannot provide for the great expense of physicians employed privately and who are not in the indigent class.

Lawrence T. Post.

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## OBITUARY

CLIFFORD BLACK WALKER, M.D.  
1884-1943

Clifford Black Walker died on July 3, 1943, at the age of 58 years. He died during an acute exacerbation of a prolonged illness. This illness had interrupted his research of incalculable importance on separated retina.

Dr. Walker was born in Cambridge, Vermont, on August 9, 1884. When he was three years of age his family moved to South Pasadena, California, where he received his preliminary education. He was graduated from the University of California in 1906 with the degree of Bachelor of Science and entered the School of Engineering, receiving his degree. In 1911 he received the degree of Doctor of Medicine with honors from Johns Hopkins Medical School.

It was at Johns Hopkins that Dr. Walker's genius was first recognized. Dr. Harvey Cushing referred to him as "the modern Helmholtz." Dr. Cushing influenced Dr. Walker to come to Boston and in association with Cushing he did his

notable work on visual-field studies in relation to neurologic conditions.

Dr. Walker entered the Massachusetts Eye and Ear Infirmary, taking both Eye and Ear, Nose, and Throat residencies. During his years there and thereafter his inventive and mechanical ability led to his designing numerous ophthalmic instruments.

Dr. Walker finally became interested in the problem of separated retina, work for which he seemed predestined because of his natural mechanical ability, his mathematical mind, his interest in electrical engineering, and his inexhaustible imagination. He undertook the problem with a zeal and thoroughness that seemed fanatical to anyone not a perfectionist. One incident may illustrate this. A farewell party was being given for Colonel and Mrs. Robert E. Wright by the Los Angeles Research Study Club. Throughout dinner and the entertainment that followed, Dr. Walker sat at a table in an obscure corner working on some electrodes for treating macular holes. Several people remarked to Colonel Wright about his eccentricity. No one knew that Dr. Walker was getting instruments ready for Colonel Wright to take back to India and there were but a few hours before he would be leaving. Some months later I heard Colonel Wright remark that whatever Dr. Walker's eccentricities might be, his instruments were the most perfect he had ever used.

Dr. Walker's efforts on detached retina soon bore fruit. His local colleagues, expressing deep respect for him and trust in his work, openly agreed to refer all detachment cases to him. This meant he observed and treated an exceptionally large number of cases. The results of his concentrated effort were manifested in an increase in cases cured from approximately 25 to 80 or 90 percent. Over a period of

about 15 years his technique became more and more perfect, and results more and more consistently satisfactory. Even today few ophthalmologists anywhere realize the possibility of so high a percentage of cures. They will achieve them only when Dr. Walker's ideas and methods are better understood. He knew the literature on the subject completely, and his technique incorporated the best ideas with his own.

Dr. Walker was present at all local or national meetings where any phase of detachment of the retina was presented. Like most truly research-minded men, he was not interested in achieving fame through priority in publication or in economic reward, but was content to solve problems in his own mind. For this reason much of his work may be lost unless one ferrets it out of the proceedings of local eye meetings. He realized that time was short for what he wanted to accomplish and worked to an extreme that hastened his collapse. When younger associates warned him that he might defeat his own purpose, he would remark that, after all, Newton wasn't producing after he was 35 years old, and he had to work before his brain was too old to have ideas. He always felt there "wasn't enough time." He begrudged the hours he spent sleeping.

Dr. Walker was clinical professor of surgery (ophthalmology) at the University of Southern California School of Medicine; formerly professor of clinical ophthalmology at the College of Medical Evangelists; at one time assistant in ophthalmology at the Harvard Medical School, Boston; served as a member of the American Board of Ophthalmology.

He was a member of the American Academy of Ophthalmology and Otolaryngology, American Ophthalmological Society, Association for Research in

Ophthalmology, Western Ophthalmological Society, and the Pacific Coast Otolaryngological Society.

He was past president of the Los Angeles Society of Ophthalmology and Otolaryngology; served on the staff of the California Hospital, Eye and Ear Hospital, Good Hope Clinic, Los Angeles County Hospital, and Hospital of Good Samaritan; formerly on the staff of the Peter Bent Brigham Hospital, Boston.

In 1914, Dr. Walker received the first Knapp Medal from the Section on Ophthalmology of the American Medical Association for his paper on "Topical diagnosis of the hemiopic pupillary reaction and the Willbrand hemianopic prism phenomenon, with a new method of performing the latter."

Dr. Walker had a loving and appealing personality, born of true sympathy and consideration for his fellow men. He

was a gracious host, an ideal companion for a medical meeting, and in any gathering could entertain with lively and witty discussion and repartee on any subject. His fund of knowledge related to economics, politics, music, or the arts, including culinary, was most amazing. He was very modern in his interest and his way of life. He was the first in town to have an automatic gear-shift, a Novachord, or any other modern invention that was worthwhile.

Dr. Walker is survived by his wife, Mary McAvoy Walker, who has been patient and understanding throughout their 20 years of married life, appreciative of his efforts in the pursuit of scientific truth. To her and to his friends and associates, Dr. Walker's death means a great and irrevocable loss.

S. Rodman Irvine.

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This is to remind you that if you have interesting refraction cases, the proposed Refraction Department of the Journal would like to consider them for publication. Send your histories to the editor.



# ABSTRACT DEPARTMENT

EDITED BY DR. WILLIAM H. CRISP

Abstracts are classified under the divisions listed below, which broadly correspond to those formerly used in the Ophthalmic Year Book. It must be remembered that any given paper may belong to several divisions of ophthalmology, although here it is mentioned only in one. Not all of the headings will necessarily be found in any one issue of the Journal.

## CLASSIFICATION

1. General methods of diagnosis
2. Therapeutics and operations
3. Physiologic optics, refraction, and color vision
4. Ocular movements
5. Conjunctiva
6. Cornea and sclera
7. Uveal tract, sympathetic disease, and aqueous humor
8. Glaucoma and ocular tension
9. Crystalline lens
10. Retina and vitreous
11. Optic nerve and toxic amblyopias
12. Visual tracts and centers
13. Eyeball and orbit
14. Eyelids and lacrimal apparatus
15. Tumors
16. Injuries
17. Systemic diseases and parasites
18. Hygiene, sociology, education, and history
19. Anatomy, embryology, and comparative ophthalmology

### 3

#### PHYSIOLOGIC OPTICS, REFRACTION, AND COLOR VISION

Yasuna, Elton. Homatropine-paredrine emulsion as a cycloplegic. *Arch. of Ophth.*, 1943, v. 30, July, pp. 87-92.

There has been considerable literature in the last few years upon the cycloplegic action of a mixture of homatropine and paredrine. The author reports further work on the problem, his study differing in three respects from that of any previous report. Firstly, instead of an aqueous solution, an emulsion was used consisting of paredrine, homatropine, acacia, liquid petrolatum, glycerine, merthiolate, and water. Secondly, refraction was performed on each subject with the cycloplegic alone, either atropine sulphate or homatropine hydrobromide, and then with the homatropine-paredrine emulsion. The third difference was that the study was limited to hyperopic children from five to 16 years of age.

Forty-six percent of the subjects studied with atropine sulphate accepted more plus sphere with this cycloplegic than with paredrine-homa-

tropine emulsion; 19 percent accepted less plus sphere, and in 35 percent of the cases the results were identical. One drop of an emulsion of paredrine hydrobromide plus homatropine hydrobromide is a better cycloplegic than one drop of an aqueous solution of homatropine hydrobromide instilled every ten minutes for one hour.

At the time of the refraction under the emulsion each patient was given a questionnaire. The reports indicated that the average child was able to read in about 16 hours, and that the average time for complete wearing off of the effect was 24 hours. Most patients preferred this method of cycloplegia. (References.) Ralph W. Danielson.

### 4

#### OCULAR MOVEMENTS

Gill, E. G., and Gressette, J. M. Management of crossed eyes based upon observation of 46 cases. *Virginia Med. Monthly*, 1942, v. 69, Aug., pp. 420-422.

Each strabismus case presents variations which make diagnosis and treat-

ment difficult problems. The questions will arise whether a case is medical or surgical and what type of treatment is indicated, whether we can strive for only cosmetic or for cosmetic and physiologic results, or whether orthoptic training is of any avail. In order to arrive at a proper diagnosis, a definite routine examination is of importance. The visual power, the fusion faculty, and diplopia reactions are to be determined as well as the behavior of the eye movements under concomitant tests and the amount of deviation with and without glasses for far and near, and with and without cycloplegia. The writers classify strabismus as follows: pseudoparalytic, accommodative, due to or associated with fusion defects, due to or associated with amblyopia, due to or associated with neuromuscular defects, due to or associated with anisometropia, and due to or associated with multiple defects or hereditary tendency. The treatment should begin as soon as the squint becomes manifest, regardless of age. For orthoptic training the age of the patient should be not less than four years, the vision in the poorer eye should be at least 20/40, and retinal correspondence must be normal. As to surgery the authors use the Lancaster resection or a recession method for lateral strabismus. Surgical treatment is resorted to if the medical treatment is not successful in 6 to 12 months. (Bibliography, 7 figures.)

Melchior Lombardo.

Guibor, G. P. Ophthalmic prisms, some uses in ophthalmology. *Amer. Jour. Ophth.*, 1943, v. 26, Aug., pp. 833-845. (One chart, 6 diagrams, references.)

Hicks, A. M. Congenital paralysis of lateral rotators of eyes with paralysis

of muscles of face. *Arch. of Ophth.*, 1943, v. 30, July, pp. 38-42.

Congenital bilateral paralysis of the muscles which move the eyes in the horizontal plane and congenital bilateral paralysis of the muscles of the face occasionally occur together. The author reviews the literature and gives reports of four cases. (References.)

Ralph W. Danielson.

Leopoldsberger, W. Influence of external factors upon the fusion faculty. *Wiener klin. Woch.*, 1942, Sept. 4, pp. 705-711. (See Section 3, Physiologic optics, refraction, and color vision.)

Luckiesh, M., and Moss, F. K. Initial and residual effects of ophthalmic prisms on visibility and accommodation. *Arch. of Ophth.*, 1943, v. 29, June, pp. 968-974. (See Section 3, Physiologic optics, refraction, and color vision.)

## 5

### CONJUNCTIVA

Feldman, L. A., and Sherman, H. Hypersensitiveness of the mucous membranes. 3. Slitlamp studies of the conjunctival reactions induced in normal and in atopic persons with histamine, ethylmorphine, and atopens. *Arch. of Ophth.*, 1943, v. 29, June, pp. 989-995.

The bulbar conjunctiva provides an ideal site for slitlamp study of reactions produced by application of various substances to the conjunctiva. A number of eyes were studied in this manner and the resulting reactions recorded. When histamine or an allergin was instilled, the blood vessels dilated in the following sequence: deep large vessels, superficial fine vessels, superficial large vessels, and finally the deep

fine vessels. The histamine and allergin reactions could not be differentiated. Ethylmorphine hydrochloride produced dilatation mainly of the deep network and then slightly of the superficial vessels. Epinephrine hydrochloride produced contraction of the vessels equally after all types of reaction. No essential difference was found between the specific reactions to antigens induced in the naturally sensitive conjunctiva and that produced in the passively sensitized conjunctiva. Itching was characteristic of the reaction to pollen. With histamine and ethylmorphine itching was usually absent but some of the subjects complained of a burning sensation. (4 tables.)

John C. Long.

McCulloch, J. C. Origin and pathogenicity of *Pseudomonas pyocyanea* in conjunctival sac. Arch. of Ophth., 1943, v. 29, June, pp. 924-935.

*Pseudomonas pyocyanea* has long been known to produce a serious infection of the eye, often with the formation of corneal ulcer. The organism may be present in the normal flora of the eye, may be introduced by the use of contaminated eye drops, or may get into the eye from infection elsewhere in the body.

A search of the bacteriologic data in about 5,000 case records of eye diseases observed at the Institute of Ophthalmology and Vanderbilt Clinic yielded 18 cases in which *Ps. pyocyanea* had been demonstrated. In 28 percent of these cases it was found that the infection had been introduced through the use of contaminated eye drops. The organism produced corneal ulcer, endophthalmitis following iridectomy, meibomitis, and infection after trephining. Cultures were made

of samples from all bottles of ophthalmic solutions used in the hospital and in some private offices. The *Ps. pyocyanea* was found in an occasional bottle of pontocaine hydrochloride, pilocarpine hydrochloride, ethylmorphine hydrochloride, scopolamine hydrobromide, and atropine sulphate solution. Contamination of physostigmine salicylate and fluorescein was very frequent, especially the former. It was noted that if the solutions contained the organism, it was nearly always in pure culture, as the germ produces antibacterial agents.

Various antiseptic agents were added to eye solutions containing *Ps. pyocyanea*. It was found that considerably higher concentrations were needed to sterilize physostigmine salicylate than to sterilize fluorescein. Boiling the solutions, and changing them frequently, seems to be the best way to assure sterility. A small amount of sodium sulphite will prevent the physostigmine solution from turning red.

A culture of *Ps. pyocyanea* was instilled into rabbit eyes. It was found that conjunctivitis did not develop unless the eye was occluded. The latter also increased the incidence and severity of corneal invasion in experimentally infected ulcers. A filtrate of *Ps. pyocyanea* culture produced a severe conjunctivitis when instilled into rabbit eyes, suggesting that toxic material released by the bacilli is probably responsible for *Ps.-pyocyanea* conjunctivitis.

A number of sulfonamide compounds were tested in vitro against the organism. Of those tested, it was found that sulfathiazole and sulfadiazine were the most effective. (2 tables, references.)

John C. Long.

## 6

## CORNEA AND SCLERA

Conners, C. A., Eckardt, R. E., and Johnson, L. V. Riboflavin for rosacea keratitis, marginal corneal ulcers and catarrhal corneal infiltrates. *Arch. of Ophth.*, 1943, v. 29, June, pp. 956-967.

Rosacea keratitis, marginal corneal ulcers, and catarrhal corneal infiltrates all respond promptly to parenteral injection of riboflavin. These conditions are thought to result from actual or relative insufficiency of the flavoprotein enzymes. Riboflavin is a component of at least nine enzymes that play an important role in cellular respiration. It is probable that the effect of Warburg's yellow enzyme is insignificant.

The average riboflavin excretion and, hence, the intake of a series of patients with rosacea keratitis, was found to be considerably less than in a control group. Retention tests after intramuscular injection of riboflavin indicated that patients with rosacea were deficient in this substance.

In the series studied, only one patient with typical superficial marginal infiltrates failed to respond to intravenous use of riboflavin and oral administration of vitamin-B complex. This patient promptly recovered when riboflavin mixed with whole blood was injected. It is thought that the whole blood supplied some factor or initiated some process necessary for the metabolism of riboflavin. Corneal disease may result either from a diet deficient in riboflavin or from some disorder in the metabolism of riboflavin enzymes. (4 tables, references.)

John C. Long.

Farber, J. E., and Margulis, A. E. Blue scleras, brittle bones, and deaf-

ness. *Arch. Internal Med.*, 1943, v. 71, May, pp. 658-665.

The authors report a previously unrecorded family of 57 members, 12 of whom have been affected with the blue-scleras syndrome. Seven of the 12 members have both blue scleras and brittle bones. Four have these defects with deafness, and one has only the blue scleras. Eight of the affected members are males; four, females. The condition is transmitted from generation to generation, affecting four generations in the detailed genealogic family tree presented. Three members of the group have been studied in detail.

T. E. Sanders.

Folk, M. R. Marginal degeneration of cornea. *Arch. of Ophth.*, 1943, v. 29, June, pp. 975-980.

Marginal degeneration of the cornea is a disease of unknown causation, is usually bilateral, and affects males in about 75 percent of the cases. Approximately 559 cases have been described in some detail in the literature. The disease is probably not rare, but many cases escape detection because of its mildness. Typically the disease starts with a peripheral opacity closely resembling and usually superimposed on an arcus senilis. Gradually a gutter-like furrow appears, usually between the arcus and the limbus, but occasionally central to it. The epithelium is not destroyed but the gutter deepens with a shelving peripheral and steep central margin. The furrow becomes vascularized. As the gutter gets deeper an ectasia results from intraocular pressure. Finally there may be perforation of the furrow with prolapse of the iris. The process is extremely slow, and the development of ectasia may require ten to twenty years. The chief symptom is visual failure due to the development

of gross astigmatism although at times there are irritative symptoms similar to those of a mild conjunctivitis.

The author reports a case of this condition in a man of 21 years. The patient complained of recurring attacks of irritation and slight photophobia. The eyes showed slight pericorneal injection and a corneal opacity. This opacity was circular and near the limbus, varying in width from 3 mm. vertically to 1.5 mm. horizontally. A pannus covered the entire opacity and within the opacity there were many chalky, punctate opacities. The slit-lamp showed some areas of beginning ectasia. The corrected vision of each eye was 0.8. Treatment consisted of sulfanilamide orally and sulfathiazole ointment locally. In addition, large doses of vitamins A, B, and D were given and tinted lenses prescribed. The patient showed improvement and the photophobia disappeared. The author states that it is too soon to predict the results and to claim that this is the proper method of treatment. (2 illustrations, references.) John C. Long.

Pullinger, B. D. A technique for the microscopic examination of the cornea. *Jour. Path. and Bact.*, 1943, v. 60, Jan., pp. 97-99.

The author describes a new technique for silver staining of the cornea, especially useful for demonstrating the corneal corpuscles. It is also of particular use in experimental work not adaptable to routine histologic examination.

T. E. Sanders.

Perritt, R. A. Corneal transplantation. *Arch. of Ophth.*, 1943, v. 30, July, pp. 14-24.

The author presents the evolutionary stages through which his work on corneal transplantation has passed. He

discusses sources of transplants, preservation of the eyes, examination of the recipient eye, indications and contraindications for surgery, histologic prerequisites of the leukoma, and microscopic studies of the transplant.

Cases have been classified into three groups: favorable, unfavorable, and for cosmetic effect alone. Cases are favorable only if (1) intraocular tension is normal, (2) the diseased ocular tissue is limited to the cornea, (3) the corneal leukoma is not very dense although sufficiently so to cause considerable impairment of vision, and (4) clear areas surround the leukoma. The prognosis is favorable in quiet interstitial keratitis, keratoconus, blood staining of the cornea, and central circumscribed corneal leukoma.

The outlook is unfavorable when (1) a dense leukoma extends over almost the entire cornea, (2) there is aphakia, (3) the intraocular tension is increased, or (4) there is corneal cloudiness with densely vascularized pannus. In this group of cases preliminary operations must be performed before corneal transplantation in order to prepare a more favorable soil for final keratoplasty. (11 case reports, 11 figures, references).

Ralph W. Danielson.

## 7

### UVEAL TRACT, SYMPATHETIC DISEASE, AND AQUEOUS HUMOR

Ellis, O. H. Free-floating cyst of the anterior chamber. *Amer. Jour. Ophth.*, 1943, v. 26, Aug., pp. 859-860. (References.)

Meesmann, A. Practical importance of pupillary disturbances. *Med. Klinik*, 1942, v. 38, Oct. 9, pp. 971-973.

The author discusses briefly amauro-

rotic, reflex, and absolute pupillary paralysis, and the tonic pupil. Kehrre and Adie have described 12 different types of the latter, the classification depending mainly on its association with other reflex anomalies. Absence of the patellar reflex is found in about 60 percent, and exaggeration of this reflex in about 20 percent. Vasomotor disturbances, migraine, and pituitary symptoms are often found simultaneously. A hereditary disposition seems to play a role in development of pupillary disturbances after infectious diseases, alcoholism, and other factors.

Bertha A. Klien.

Rooks, J. T. Adie's syndrome. *Arch. of Ophth.*, 1943, v. 29, June, pp. 936-941.

Adie's syndrome consists of a unilateral myotonic pupil associated with the loss of one or more of the deep tendon reflexes. The myotonic pupil is usually present in one eye only, is sometimes oval or irregular in shape, is nearly always larger than its fellow, and is occasionally widely dilated. It may be partially or wholly inactive to light and incompletely or entirely inactive to accommodative effort. Adie's syndrome is of unknown etiology and does not affect the general health or life expectancy.

The author reports two cases of this condition. The first is of a 44-year-old man. The left pupil was dilated and failed to respond either to light or to accommodation. The knee, ankle, and cremasteric reflexes on the right side were absent. The second patient was a 55-year-old man. His right pupil was irregular and dilated. It did not respond to light and accommodation in the usual way. The ankle reflexes were absent and the patellar reflex was elicited on the right side only after re-

enforcement. Neither patient gave any evidence of syphilis. (References.)

John C. Long.

Scheie, H. G., Moore, E., and Adler, F. H. Physiology of aqueous in completely iridectomized eyes. *Arch. of Ophth.*, 1943, v. 30, July, pp. 70-74; also *Trans. Amer. Ophth. Soc.*, 1942, v. 40, p. 245.

It has been established that the aqueous humor contains less urea than the circulating blood. Urea should be present in equal amounts in aqueous and blood if the aqueous is formed by dialysis alone. The low urea content of aqueous has been attributed to lack of permeability of the blood-aqueous barrier to urea. The aqueous urea equals the blood urea only under one condition, and that is after the anterior chamber has been opened, the aqueous evacuated, and the secondary or plasmoid aqueous allowed to form.

In an attempt to throw light on these problems the authors iridectomized a large number of cat eyes and made various determinations. The fluid which reforms in the iridectomized eye has a higher protein content than the original aqueous, but never approaches that in an eye with an attached iris. The volume of the anterior chamber was considerably reduced, being approximately 40 percent less than normal. The tension was reduced 60 percent below normal. The high protein content of the secondary aqueous in normal eyes probably comes from the iris. The iris may also be concerned with the formation of normal aqueous.

A number of practical points are suggested by these results. When there has been a hemorrhage into the anterior chamber as a result of trauma, it is probably better not to dilate the pupil, since absorption of blood seems

to depend on the presence of the iris stroma. A basal iridectomy for glaucoma not only should be basal but should be broad. Part of the effect may be elimination of a portion of the filtering surface as well as freeing of the chamber angle. (4 tables, references.) Ralph W. Danielson.

Schlaegel, T. F., Jr., and Davis, J. B. The reaction of the rabbit eye to normal horse serum. *Amer. Jour. Ophth.*, 1943, v. 26, Aug., pp. 785-798. (2 tables, 9 photomicrographs, references.)

## 8

## GLAUCOMA AND OCULAR TENSION

Posner, Adolph. Standardization and checking of Schiötz tonometers. *Arch. of Ophth.*, 1943, v. 30, July, pp. 1-13.

Every ophthalmologist has at one time or another doubted the reliability of his tonometer, and unfortunately has not had an adequate method or place for having his tonometer checked. In Europe checking stations were established about 1925, but the author organized the only one in the United States and it operated only from 1935 to 1939.

The Committee on Glaucoma of the National Society for the Prevention of Blindness is now establishing a checking station for Schiötz tonometers at 1790 Broadway, New York.

This article discusses the specifications for a tonometer, the equipment of a checking station, and the procedure of checking tonometers. (References, 7 figures.)

Ralph W. Danielson.

## 9

## CRYSTALLINE LENS

McKee, T. L. Restoration of binocular vision after unilateral cataract ex-

traction. *Arch. of Ophth.*, 1943, v. 29, June, pp. 996-999. (See Section 3, Physiologic optics, refraction, and color vision.)

## 10

## RETINA AND VITREOUS

Bock, R. H. Diabetic retinosis in the Chinese. *Arch. of Ophth.*, 1943, v. 29, June, pp. 919-923.

Among 183 Chinese patients with diabetes, 49 had diabetic retinosis. The age group with the highest incidence of retinosis was that between 50 and 60 years. The average duration of the diabetes before the onset of the retinal condition was seven years. It was noted that the blood sugar of diabetic patients with retinosis was consistently higher than in patients without it. Thus the average fasting blood sugar of those with retinosis was 209 mg. per hundred c.c., while those without retinal damage had an average of only 174 mg.

Renal function tests showed no greater incidence of impaired function in patients with retinosis than in those without. Also there was found to be no difference in the incidence of hypertension, arteriosclerosis, acetone bodies and cholesterol. The lesions of diabetic retinosis are most likely of capillary origin. It may be assumed from these statistical data that an increased blood-sugar content persisting over a long period damages the capillaries and thus indirectly is the cause of the fundus change. (References.)

John C. Long.

Bower, L. E., Ditkowsky, S. P., Klien, B. A., and Bronstein, I. P. Arteriovenous angioma of mandible and retina with pronounced hematemesis and epistaxis. *Amer. Jour. Dis. Children*, 1942, v. 64, Dec., p. 1023.

A nine-year-old boy was admitted to the hospital for frequent epistaxis and hematemesis. At the admission an almost imperceptible bluish discoloration was found over the lower part of the left cheek. A thrill and a bruit synchronous with the entire cardiac cycle were elicited over this area. Roentgen examination revealed large cystic spaces in the left mandible. The lower incisors and the first molar were loose and movement of the teeth caused bleeding. After removal of the molar an infection set in and after healing the roentgenogram failed to show the cystic spaces previously noted. The X ray further revealed that the left optic foramen was enlarged. The left pupil did not react to light. Fundus examination disclosed that from the optic disc a large number of tremendously dilated and dark-colored, tortuous vessels emerged, among which the arteries and veins were barely distinguishable and some branches near the disc were three to four times their normal size. The vessels formed pre-retinal and prepapillary loops, but toward the periphery they again took on a normal appearance. There were no retinal nodes or tumors. The conglomeration of dilated, tortuous, and dark-colored vessels pointed to the existence of an arteriovenous communication.

R. Grunfeld.

# 11

## OPTIC NERVE AND TOXIC AMBLYOPIAS

Argüello, D. M., Lambre, P., and Tosi, B. Concerning a case of Crouzon disease. *Arch. de Oft. de Buenos Aires*, 1941, v. 16, Dec., p. 665.

The authors report a case of cranio-facial dysostosis or Crouzon disease, in an 11-year-old girl. Hereditary antecedents were entirely negative. The vi-

sion was considerably reduced by the presence of optic atrophy, but X-ray examination of the skull showed the optic foramina to be essentially normal. The patient was of average intelligence. (Photographs, X-rays, bibliography.)

Plinio Montalván.

Faber, H. K., and Towne, E. B. Early operation in premature cranial synostosis, for the prevention of blindness and other sequelae. *Jour. of Pediatrics*, 1943, v. 22, March, p. 286.

As soon as premature synostosis of the cranial sutures has been diagnosed, the authors advocate excision of strips of bone parallel to the closed suture or sutures. The operation has to be performed early in infancy, preferably before the age of six months. By early operation, loss of vision, exophthalmos, cranial deformity, convulsions, and other serious sequelae can be prevented.

Five case histories are given. All five patients were operated on early, and the operative results are highly satisfactory. The three older patients, 17, 13, and five years after the operation, now have normal vision, normal appearance, normal cranial circumference, and intelligence of superior grade.

R. Grunfeld.

Fink, W. H. The ocular pathology of methyl-alcohol poisoning. *Amer. Jour. Ophth.*, 1943, v. 26, July, pp. 694-709, and Aug., pp. 802-815. (References.)

Hansraj, J. Kroenlein's operation for a case of cyst of the optic nerve. *Indian Jour. Ophth.*, 1943, v. 4, Jan., pp. 6-8.

Proptosis in a 32-year-old woman had developed slowly for about three years. The vision was failing rapidly and was reduced to counting fingers at five feet when the patient was first



seen by the writer. There were pain and restricted motion of the globe but temperature and blood-count were normal. Diagnostic puncture behind the globe drew out a few drops of serous fluid. Kroenlein's operation was done in preparation for removal of a possible tumor, but revealed a cyst of the optic nerve. The cyst wall was firmly adherent to Tenon's capsule and only parts of it could be removed. The cyst refilled twice within a few days after the operation, and was emptied by repeated punctures. After a month there was no reappearance of the proptosis and vision had returned to normal.

Jerome B. Thomas.

Kravitz, D. Pigmentation of the optic disc. *Arch. of Ophth.*, 1943, v. 29, May, pp. 826-830.

Kravitz reviews the literature and then reports three cases, very probably congenital, in young people. These cases were found by fundus examinations incidental to refraction and, as one would expect, produced no symptoms. The appearance of the pigmented spots gave the impression that they were congenital pigmented nevi similar to those found on the skin. Interesting was the presence of a cilio-retinal vessel in every case. The author agrees with the explanation given by Duke-Elder and Mann, that the pigment arises from primitive cells of the optic stalk which have regressed and developed characteristics of pigment-forming cells in a place where they should have developed other functions. Probably the anatomy of the optic disc, with the sparseness of fibers and vessels on the temporal side, makes this the usual site of predilection. (References, 2 drawings.) Ralph W. Danielson.

Loewenstein, A. Marginal hemorrhage on the disc. Partial cross tearing

of the optic nerve. Clinical and histological findings. *Brit. Jour. Ophth.*, 1943, v. 27, May, pp. 208-215.

An ophthalmoscopic picture not hitherto mentioned in the literature is described. The patient had a perforating wound in the sclera, caused by the dropping of a nail from a considerable height into his right eye. Examination revealed a clear cornea with deep anterior chamber, 2 mm. of hyphema, and a small pupil with clear lens and a dull fundus reflex. No fundus details were visible and there was severe hypotonia. The vision was fingers at 0.5 m.

Fourteen days later, in spite of diffuse vitreous opacities, a clear red arcuate band was visible at the temporal margin of the disc. The breadth was that of the central vein, and a pigment ring outlined the temporal margin of the red band. The marginal hemorrhage remained unchanged in appearance during two months of observation. Three fine radial striate hemorrhages around the disc vanished during this period of observation.

From analyses of histologic findings in other cases, the marginal arcuate hemorrhage is explained as due to a cross tear of peripheral nerve fibers at the insertion of Bruch's membrane. (6 illustrations, references.)

Edna M. Reynolds.

Ryan, E. Optochiasmic arachnoiditis. *Arch. of Ophth.*, 1943, v. 29, May, pp. 818-830.

The author says there are still too few ophthalmologists who recognize the importance of this disease, its dire consequences to vision if not early diagnosed or suspected, and the excellent results that may be obtained by surgical intervention. The symptomatology is varied, but visual loss and headache are in the great majority of

cases the only symptoms complained of. The fundi may be completely normal, or examination may disclose a choked disc or an optic-nerve atrophy of either the primary or the secondary type. Any type of field defect may be encountered.

Ryan refers to the paper by Hausman in which attention was called to the important role played by syphilis in arachnoiditis, and in which the syphilitic forms were classified in three distinct groups (*Arch. of Ophth.*, 1940, v. 23, p. 1107). Heretofore when specific fundus disease and field defects were encountered in syphilis, they were almost universally considered to be due to parenchymatous disease of the nerve, regardless of evidence of tabes. The possibility that adhesions about the nerves and chiasm may cause the pathologic change has been insufficiently considered. Patients with this type of arachnoiditis should be treated energetically.

Three cases of optochiasmic arachnoiditis are reported, two in childhood and one in middle age. (Fields, references.) Ralph W. Danielson.

Steinberg, Theodore. Coloboma of the optic nerve. *Amer. Jour. Ophth.*, 1943, v. 26, Aug., pp. 846-849. (One fundus photograph, fields, bibliography.)

## 12

### VISUAL TRACTS AND CENTERS

Bender, M. B., and Savitsky, N. Micropsia and teleopsia limited to the temporal fields of vision. *Arch. of Ophth.*, 1943, v. 29, June, pp. 904-908.

Micropsia, teleopsia, and metamorphopsia are usually associated with lesions of the retina, cortex, or occipital lobe. The authors report the case of a 35-year-old man with diabetes in-

spidus and other general symptoms of a lesion in the region of the chiasm. The patient had multiple small irregular scotomas in the temporal fields, chiefly in the inferior quadrants. Throughout these areas also there were definite micropsia, teleopsia, and a tendency to reverse or turn the image of the object observed. Operation and later autopsy showed an epidermoid tumor in the interpeduncular space, compressing the chiasm and the floor of the third ventricle. There was no brain lesion posterior to this region. This is an example of visual aberrations arising from a peripheral lesion, with no disturbance of the cortex or occipital lobe. (Fields, charts, references.) John C. Long.

Chace, R. R. Structural changes in external geniculate body of rat following removal of eyes. *Arch. of Ophth.*, 1943, v. 30, July, pp. 75-86.

For many years research has been carried out on the problem of the cellular response in the developing nervous system to the presence or absence of peripheral stimuli. In a consideration of these responses of the central nervous system to increased or decreased peripheral demands, one finds that the optic pathways lend themselves admirably to such changes. If one destroys an optic nerve or removes an eye, there is a somewhat progressive transformation in the visual pathway. There seems to be no uniformity in the literature as to just how far back from the eye the changes extend.

Experiments were, therefore, done on newborn and adult rats. The conclusions are: (1) Removal of one eye from a newborn rat causes degeneration of the optic nerve and tract corresponding to that eye. (2) The brains of rats born with microphthalmic or

degenerate eyes lack optic nerves, chiasms, and tracts, and the external geniculate bodies exhibit a definite hypoplasia. (3) Removal of one eye in an adult animal is followed by atrophy of the optic nerve. Gross changes have not been noted in the chiasma or optic tract, nor any microscopic alterations in the external geniculate body. (7 illustrations, 1 graph, 3 tables, references.)

Ralph W. Danielson.

Frank, M., and Pijoan, M. Mumps and associated nephritis complicated by encephalitis and blindness. *Southwestern Med.*, 1943, v. 27, April, pp. 95-97.

The authors report the case of a fourteen-year-old Indian boy with acute epidemic bilateral parotitis, complicated by nephritis. After about six days headache and drowsiness supervened; three days later the patient complained of absolute blindness. This lasted about three days and the vision then rapidly returned to normal. The ophthalmological and neurological examinations were negative. No explanation is offered for the sudden loss of vision, but the symptoms of headache and drowsiness and the laboratory studies of the spinal fluid lead the authors to conclude that the essential disease complicating the parotitis was an encephalitis. The relation of the nephritis to the parotitis is not clear, but they subsided together. (9 references.)

Jerome B. Thomas.

Levin, Max. Diplopia in narcolepsy. *Arch. of Ophth.*, 1943, v. 29, June, pp. 942-955.

Narcolepsy is a syndrome characterized by brief attacks of sleep and brief attacks of flaccid paralysis without loss of consciousness. The attacks usually occur in response to some emotion,

such as laughter or excitement. The author describes in considerable detail Pavlov's work on internal inhibition and sleep, and states that attacks of narcolepsy occur with significant frequency under conditions duplicating those which in Pavlov's experiments elicited manifestations of cerebral inhibition.

This and other factors suggest that narcolepsy results from a disturbance which renders the cortex unduly exhaustible, the attacks of sleep arising from inhibition of just the motor cortex. Diplopia is frequent during attacks of this disorder and it is suggested that the diplopia arises from transitory inhibition of a cortical mechanism for binocular vision. (References.)

John C. Long.

Wagener, H. P., and Love, J. G. Fields of vision in cases of tumor of Rathke's pouch. *Arch. of Ophth.*, 1943, v. 29, June, pp. 873-887; also *Trans. Amer. Ophth. Soc.*, 1942, v. 40, p. 305.

This is an analysis of the ocular findings of 29 cases of Rathke-pouch tumors treated at the Mayo clinic. Loss of central vision in one or both eyes was observed in 26 of the 29 cases. Unilateral or bilateral central scotomas and amaurosis of one eye in association with other defects were striking features. Ophthalmoscopically the patients may present normal optic discs, choked discs, simple pallor of the discs, or simple atrophy of the nerve. Roentgenograms of the head were normal in 7 of the 29 cases. Early diagnosis and early surgical removal of the tumors is important. Late postoperative data could be obtained from only 21 of the 29 patients. Four had died. Of the remaining 17, relatively successful results were obtained from operation in 12. (Fields, 6 tables, references.)

John C. Long.

## 13

## EYEBALL AND ORBIT

Faber, H. K., and Towne, E. B. Early operation in premature cranial synostosis, for the prevention of blindness and other sequelae. *Jour. of Pediatrics*, 1943, v. 22, March, p. 286. (See Section 11, Optic nerve and toxic amblyopias.)

Lloyd, R. I. Proptosis as a diagnostic problem. *West Virginia Med. Jour.*, 1943, v. 39, March, pp. 69-76.

The writer simplifies the problem of diagnosis of proptosis by discussing the various types as they occur in age groups. The new-born infant heads the list with the serious eye injuries incurred in the birth canal, especially in forceps deliveries. Other causes of proptosis evident at birth are nasofrontal meningocele and collections of fluid beneath the periosteum of the orbital roof. Other congenital defects are neurofibromatosis; abnormal position of the eye; and the Hörner syndrome of small optic fissure, retracted eye, and small pupil, due usually to injury of the brachial plexus during birth. During the next age group, which includes children from two years on, chloroma and xanthomatosis may occur. Infections of the orbital cellular tissues are fairly common in young children, originating in the nose and ethmoid cells. To save the eye, early incision of the abscess through the upper lid at the inner corner of the orbit is important, followed by collaboration with the rhinologist to maintain adequate drainage. There is a group of osseous dystrophies, tower skull the most common, in which the eyes are prominent. A mass of hard bone may form in the ethmoidal cells, growing slowly upward into the cranial

cavity, finally breaking through into the orbit, and pushing the eye forward. Only in recent years has the attention of the profession been attracted by metastases to the orbit from abdominal malignancies, with resulting proptosis. Basedow's disease is probably the most common cause of proptosis, next to orbital infections from the paranasal sinuses. In conclusion the author emphasizes the following points: (1) Acute proptosis with orbital inflammation and pain is presumably due to an infection which has escaped from the ethmoidal cells and invaded the orbit. (2) An acute proptosis during the nursing period, in an artificially fed infant, should be treated as due to scurvy until proven otherwise. (3) Progressive proptosis coming on soon after birth should suggest hemorrhagic disease of the new-born. (4) In children, a sudden proptosis with enlargement in the temporal fossa appearing soon afterward should suggest chloroma and an examination of the blood. (5) In every case of sudden protrusion of an eye without local inflammation, especially after an accident, the stethoscope should be used to search for a bruit which will clear the diagnosis. (5 plates.) Jerome B. Thomas.

Murphy, E. S. Improvised exophthalmometer. *Arch. of Ophth.*, 1943, v. 29, May, p. 844.

On an ordinary pair of compasses, the movable leg has a grooved cross-piece, and to the fixed leg is fastened a spatula which projects 18 mm. beyond the plane of the shorter leg. The groove is placed on the lateral wall of the orbit, the spatula on the center of the cornea. The reading on the protractor scale in degrees is multiplied by three, to give the amount of the proptosis in millimeters. The readings agree

with those of the Hertel exophthalmometer. (2 photographs.)

Ralph W. Danielson.

O'Malley, C. L. C. Orbital emphysema simulating cellulitis. *Brit. Jour. Ophth.*, 1943, v. 27, May, pp. 222-226.

Orbital emphysema with protosis was so severe that the eye was subjected to both exposure necrosis and strangulation from the tense eyelids and swollen conjunctiva. A diagnosis of orbital cellulitis was made and the orbit was opened. After the escape of a large amount of gas, the eyeball immediately settled into the orbit, and uneventful recovery followed.

Edna M. Reynolds.

Pendse, G. S. A rare congenital ocular abnormality. *Indian Jour. Ophth.*, 1943, v. 4, Jan., p. 1.

The writer reports a case of double anophthalmos accompanied by a small bluish cystoid swelling of the lower lid of one eye. Otherwise the lids and lashes were normal. No other abnormalities, local or general, were found. A reasonable explanation of this anomaly is that no primary optic vesicle has budded out from the anterior primary encephalic vesicle, or that, having budded out, it has failed to form a secondary optic vesicle. The bluish cysts that sometimes are connected with rudimentary eyes are located in the lower part of the orbit or in the lower lid and contain retinal elements. (4 figures.)

Jerome B. Thomas.

Smeltzer, G. K. A study of the retrobulbar tissue in experimental exophthalmos in guinea pigs with reference to primary and secondary modifications. *Amer. Jour. Anatomy*, 1943, v. 72, March, pp. 149-165.

In a series of thyroidectomized

guinea pigs exophthalmos was produced by injection of anterior-pituitary extract. The exophthalmos is dependent upon and proportional to an increase in the mass of retrobulbar tissue. This consists of edematous infiltration and hypertrophy of the orbital fat, which the author believes are the primary changes and not induced secondarily by the exophthalmos. There is also hypertrophy of the extraocular muscles which may be partly secondary to the exophthalmos.

T. E. Sanders.

## 14

### EYELIDS AND LACRIMAL APPARATUS

Berkley, W. L. Treatment of cicatricial entropion. *United States Naval Med. Bull.*, 1943, v. 41, May, p. 729.

The author describes a modified Ewing operation for the correction of cicatricial entropion of the upper or lower eyelid. A horizontal conjunctival incision is made on the everted eyelid, 3 mm. from and parallel with the lid margin. The incision goes through the entire thickness of the tarsus and the flanking portions of the tarsus must be completely divided. One needle of a doubly-armed suture is passed through the conjunctiva overlying the proximal tarsal segment midway in the incision and 1 mm. from the edge, bringing it out through the cut surface of the underlying tarsus. The needle is then passed into the cut surface of the distal tarsal segment, transfixing the entire segment plane and emerging on the skin surface above the lash margin. With the second needle a firm bite is taken through the tarsus 2 mm. lateral to and behind the original entry of the needle and brought to the skin surface 6 mm. behind the lash margin. The sutures are tightened over a rubber splint.

Together with the operations sulfonamide therapy was instituted. Good results were achieved, especially in cases with pannus and ulceration of the cornea. Two case histories are given.

R. Grunfeld.

Town, A. E. Congenital absence of lacrimal puncta in three members of a family. *Arch. of Ophth.*, 1943, v. 29, May, pp. 767-771.

The author reviews the literature of this rare anomaly and reports symptoms, treatment, and results in three cases. (1 photograph, references.)

Ralph W. Danielson.

## 15

### TUMORS

Asbury, M. K., and Vail, D. Multiple primary malignant neoplasms. *Amer. Jour. Ophth.*, 1943, v. 26, July, pp. 688-693. (4 illustrations, references.)

Bedell, A. J. Bilateral metastatic carcinoma of the choroid. *Arch. of Ophth.*, 1943, v. 30, July, pp. 25-37.

Metastatic carcinoma of the choroid is a comparatively rare condition; only about 250 cases have been reported. The author gives an exhaustive discussion of the literature and reports a case in much detail. This case report is embellished by fundus photographs in black and white and also in color.

The characteristic fundus change is primarily the appearance of a flat, pale, pinkish-gray area with a delimiting border which is faintly pigmented and with the extension in surface rather than in thickness. The tumor is usually thin. After a time there is a detachment of the retina with or without subsequent glaucoma. In most cases the growth eventually becomes bilateral, although the tumor is usually

much more advanced in one eye than in the other. The location of choice is the perimacula, but the metastasis may be in the optic nerve or ciliary body.

Clinicians must be careful not to subject the patient to an unnecessary operation. Enucleation does not stop the extension from the primary growth. The eyeball should be removed only if it is the site of uncontrollable pain. (9 illustrations including 2 color plates, extensive bibliography.)

Ralph W. Danielson.

Lloyd, R. I. Retroillumination. *Amer. Jour. Ophth.*, 1943, v. 26, Aug., pp. 799-801. (2 illustrations, references.)

McCrea, W. B. E. Glioma of the retina. *Brit. Jour. Ophth.*, 1943, v. 27, June, pp. 259-273.

A clinical and pathological study based on 12 patients suffering from glioma of the retina treated in the Royal Victoria Eye and Ear Hospital from 1938 to 1942 inclusive is presented.

Two-thirds of the patients were three years old or less when they came under observation. One patient was 67 years old (the oldest patient reported in the literature to date). In none of the cases was it possible to trace a hereditary factor. Three cases were bilateral (these were all fatal) and nine were unilateral. There was a history of trauma in two cases, five of the twelve patients are known to be dead, and six are alive and well after periods varying from four years to four months beyond excision of the eye. One case is untraced. Only one globe had definite extraocular extension. Two cases had microscopically proved invasion of the orbital tissues. One case is of extraordinary interest in

that there was recovery in spite of invasion of the optic nerve as far as the lamina cribrosa, the patient being in good health three and a half years later. All the cases with optic nerve involvement behind the lamina cribrosa died. There were eleven cases of retinoblastoma and one of neuroepithelioma (in the patient aged 67 years). (6 illustrations.)

Edna M. Reynolds.

Nano, H. M. **Fibroma of the sclero-corneal limbus.** *La Semana Méd.*, 1943, v. 50, May 13, pp. 1062-1065.

The patient was a girl aged 11 years. The growth, lying astride the limbus with its center at the 8-o'clock position, was of a slightly rosy gray color and about the size of a small pea. The surface was smooth and glistening like that of the conjunctiva elsewhere. The tumor was hard, and was not movable on the subjacent tissues. The excised growth showed the characteristic structure of a fibroma. W. H. Crisp.

Xavier, J. de Paula. **A case of retinoblastoma.** *Arquivos Brasileiros de Oft.*, 1942, v. 5, Dec., pp. 277-281.

Brief mention of two personal cases, one too far advanced for operation, the other subjected to enucleation and showing the orbital cavity in good condition two months later. (Gross and histologic photographs.)

W. H. Crisp.

## 16

### INJURIES

Atkinson, W. S. **A colored reflex from the anterior capsule of the lens which occurs in mercurialism.** *Amer. Jour. Ophth.*, 1943, v. 26, July, pp. 685-688. (4 illustrations, 2 in color, references.)

Bellows, J. G. **Local toxic effects of sulfanilamide and some of its derivatives.** *Arch. of Ophth.*, 1943, v. 30, July, pp. 65-69. (See Section 2, Therapeutics and operations.)

Benson, C. E. **Treatment of photophthalmia following exposure to the rays of the welding arc.** *United States Naval Med. Bull.*, 1943, v. 41, May, p. 737.

The welder is nowadays well protected from the action of the actinic rays, for he is shielded by his hood, but a bystander, even at a distance as great as 200 feet, may be affected by the rays of the welding arc or by a reflected flash. The author treated 73 cases with 2-percent butyn and 1-percent diethane hydrochloride, one drop every five minutes for four doses. A second group of 447 patients were treated with 0.25 percent nupercaine hydrochloride and 0.5 percent neosynephrine hydrochloride dissolved in zephyran 1 to 5000, one drop every five minutes for four instillations. Identical results were achieved with either method. Neither of them influenced the speed of tissue repair but the patients were subjectively greatly improved and were able to return to work much earlier than was the case with any other method of treatment.

R. Grunfeld.

Crawford, R. A. D. **A case of multiple intraocular foreign bodies.** *Brit. Jour. Ophth.*, 1943, v. 27, May, pp. 227-229.

A number of weakly magnetic foreign bodies entered the eye, one of them lodging on the disc. After five weeks of treatment and about 28 sessions with the Haab giant magnet the two largest particles were removed. Use of the giant magnet even with a very prolonged attempt such as was

necessary. in this case is considered preferable to use of a scleral incision and a hand magnet, especially where there is involvement of the optic disc.

Edna M. Reynolds.

Glover, L. P. Bee sting of the cornea. *Amer. Jour. Ophth.*, 1943, v. 26, July, p. 744.

Godwin, E. D. War gas injuries of the eye. *California and Western Med.*, 1942, v. 57, Nov., pp. 299-301.

Mustard gas is a clear oily fluid with an odor resembling that of mustard or garlic. It is discharged by artillery shells, trench mortars or bombs, or sprayed from aeroplanes. It is soluble in animal fat, which accounts for its rapid penetration into the skin of the eyelid. In very low concentration in the atmosphere it dulls the olfactory sense and exposure is effected without recognition. It acts upon cornea and conjunctiva as a protoplasmic poison. A latent period of from 2 to 48 hours precedes the symptoms. Reports state that 75 to 90 percent of the cases are mild and recover in about two weeks. Other cases develop more intense reaction, the cornea takes on an "orange peel" texture, the lids are edematous, and miotic due to iris spasm develops. The surface of the conjunctiva is destroyed and convalescence requires several months. Immediate adjustment of the mask as soon as the odor is detected is advised. As treatment, irrigation of the eyes with a 2-percent solution of sodium bicarbonate several times a day to decrease the bacterial flora is indicated, or a normal saline bath or a 2-percent solution of boric acid, opening the lids to let the accumulated tears escape. Another agent, used alone or with mustard gas, is lewisite, which is a vesicant similar to mustard but with

the addition of arsenic. Its ocular lesions are less destructive. (References.)

Melchior Lombardo.

Gresser, E. B. Ocular injuries in chemical warfare. *Harofè Haivri (Hebrew Med. Jour.)*, 1943, v. 1, p. 52 (in English, p. 188).

As far as eye lesions are concerned the different gases act uniformly. The severity of action depends only upon the concentration and solubility of the gas. Analysis of 1,500 cases treated in the last war revealed that 75 to 80 percent were mild lesions with no corneal involvement. The subjective complaints were: sense of burning, grittiness or sand in the eye, photophobia, and spasm of the eyelids. Ten to fifteen percent showed moderate burns with chemosis of the conjunctiva. The conjunctiva presented in parts a pearly-white appearance under which the vessels were dilated. Occasional punctiform hemorrhages were seen, and varicosities and new-formed blood vessels remained after healing had taken place. The cornea presented minute, discrete, grayish spots not stained with fluorescein but consisting of edematous epithelial cells, giving the cornea a roughened (orange-skin) appearance. Five percent of the cases were severe burns with surface loss and complications. They started out with punctate lesions, which rapidly became confluent and spread to the lower half of the cornea; or as a band across the area corresponding to the palpebral fissure. Pericorneal injection and mild iritis may accompany the lesion. Deeper ulcerations may extend over the whole cornea and may cause ectasia and perforation.

Treatment consists of continuous and copious lavage with normal saline, with weak acid, or with a 2-percent sodium bicarbonate solution. Anesthesia, band-



age, oil, or ointment is not to be used. Cold compresses and watery solutions of drugs for secondary infections are recommended. R. Grunfeld.

Griffin, E. P., Gianturco, C., and Goldberg, S. Stereoscopic method for the localization of intraorbital foreign bodies. *Radiology*, 1943, v. 40, April, p. 371.

The authors use a localizer consisting of a heavy base with a vertical mast to which is attached a movable pointer that can be fixed at any level. The end of the pointer is perforated along its axis for the insertion of a metal stem carrying an artificial eye. The corneal surface of the artificial eye is placed at a distance of exactly 1 mm. from the tip of the pointer. The artificial eye is shaped from wood to the average size of a normal human eye. Thin metal wires are placed along the corneoscleral junction and along twelve meridians and along the equator. A metal stem protrudes from the center of the corneal surface along the axis of the artificial eye.

While the patient lies prone on the table, the localizer is set in such a manner that the pointer is directed along the visual axis of the injured eye and its tip is exactly 1 mm. distant from the center of the cornea. A cassette is centered under the eye, and the position of the cassette is carefully marked. An X-ray exposure of the orbit is made. A second cassette is placed under the eye and a new exposure is made with a stereoscopic shift of 3 mm. The patient is now removed from the X-ray table and the artificial eye is placed in the tip of the localizer. A reexposure of the film is made with a low voltage, sufficient only to cast a light shadow over the previous roentgenogram of the orbit. The first cassette

is now carefully replaced in its former position as marked, and the film is re-exposed with low voltage.

Thus is obtained a stereoscopic film of the orbit upon which is cast the shadow of the artificial eye. The latter enables one to localize the foreign body with ease. R. Grunfeld.

Neame, Humphrey. Removal of small magnetic foreign body from the eye eighteen months after the date of injury. *Brit. Jour. Ophth.*, 1943, v. 27, May, pp. 226-227.

A small metallic fragment was retained in the eye for 18 months without setting up any appreciable amount of siderosis and with no symptoms except slight injection.

Edna M. Reynolds.

Ranke, O. F. Function and protection of the eye in wartime. *Klin. Woch.*, 1942, v. 21, Dec. 5, pp. 1072-1075.

Protection has to be offered against dust and strong intensities of light. Statistics show that ultraviolet light is never a source of ocular damage except in high altitude. Any kind of glass, even untinted, has sufficient absorptive power against ultraviolet rays to afford proper protection, provided the spectacles fit so that lateral radiation is also eliminated.

Protection from the visible part of the spectrum has to be planned in relation to actual retinal damage, and to discomfort caused by glare. The intensity of the light causing glare may vary from 3,000 to 10,000 lux, and an absorptive power of 75 percent by the protective lens is chosen by the army.

Graphs included in this paper show the absorption of ultraviolet light by different kinds of glass, the intensity of illumination of a horizontal plane at various heights of the sun, which va-

ries from 25,000 to 100,000 lux, and the light reflection of different types of soil and street coverings.

Bertha A. Klien.

Rychener, R. O., and Ellett, E. C. Abscess of the crystalline lens. *Amer. Jour. Ophth.*, 1943, v. 26, July, pp. 715-720. (7 illustrations, references.)

Staton, D. E. Certain eye observations. *The Mississippi Doctor*, 1943, v. 20, Jan., p. 348.

Four small pieces of a nonmagnetic alloy—babbitt—were found deeply embedded in the cornea and were left there. One year elapsed and the eye tolerated the alloy well.

A splinter of wood struck the only good eye of a 24-year-old man and made a quarter-inch-wide penetrating wound one eighth of an inch posterior to the limbus. Vitreous was oozing out of the wound when the author saw the patient thirty hours later. The author sutured the sclera but not the conjunctiva. The eye made a remarkable recovery, with vision of 20/30.

A nine-year-old boy was struck on the eye with a piece of concrete. It caused pain, redness, swelling, and blood in the anterior chamber which later stained the cornea badly. Three weeks later the other eye began to show signs of sympathetic ophthalmia, photophobia, tenderness, loss of vision, and slight haziness of the corneal endothelial layer. Beside atropine and sodium salicylate by mouth, five intramuscular injections of 20 c.c. of blood were given at three-day intervals. The sympathetic ophthalmia was cured completely.

A pneumococcus ulcer became worse under curettage and cauterization. It extended over the whole lower part of the cornea. Sulfathiazole 20 gr. by

mouth four times a day and 2-percent numoquin hydrochloride solution four times a day were without benefit. Thereafter 10-percent sulfathiazole was applied to the wound and sulfadiazine was given by mouth, and soon a distinct improvement was noted.

In another case of pneumococcus ulcer sulfathiazole was dusted locally every two hours for four days, and every three hours for the next four days. Five days later the patient was considered well and was discharged.

R. Grunfeld.

## 17

### SYSTEMIC DISEASES AND PARASITES

Allende, F. P. Ocular signs in brother and sister with juvenile tabes and general paralysis. *Anales Argentinos de Oft.*, 1942, v. 3, April-May-June, p. 72.

A brother aged 22 and a sister aged 24 years, affected by inherited syphilis, are reported upon by Allende. They presented the picture of regular, unequal, light-rigid, and widely dilated pupils. The nerveheads and vision were normal. There were also symptoms of general paralysis. The cases are minutely described. Eugene M. Blake.

Argañaraz, Raúl. Ocular syphilis. *La Semana Med.*, 1943, v. 50, April 29, pp. 911-922.

This 12-page article presents to the general physician a useful review of the incidence of ocular syphilis and descriptions of a number of the most frequent manifestations of syphilis in the eye, including those seen with the ophthalmoscope. (11 illustrations in color, tables, one graph.) W. H. Crisp.

Ayo, Corrado. A toxic ocular reaction. 1. New property of Shwartzman

toxins. *Jour. of Immunology*, 1943, v. 46, March, p. 113.

The phenomenon of local tissue-reactivity to bacterial filtrates, also called the Shwartzman phenomenon, results from combined use of local and intravenous injections of bacterial toxins. Shwartzman produced local hemorrhagic necrosis in rabbits at previously prepared skin-sites, following intravenous injection of filtrates from cultures of certain microorganisms. The bacterial products causing this reaction are mainly derived from gram-negative microorganisms. Guillery (1912) and Woods (1916) observed iridoconjunctival hyperemia in rabbits injected intravenously with filtrates of *chromobacterium prodigiosum* and coliform bacteria, and they suggested a possible bearing on bilateral uveitis and other human intraocular conditions. All the bacterial filtrates potent for the Shwartzman phenomenon, but none of the others, produced the ocular reaction. Numerous bacterial cultures were grown and centrifugated by the author, who describes in detail the methods and materials used in his research. Experimental observations are given on (1) ocular reaction to meningococcal toxin in rabbits, (2) regularity of occurrence of the toxic ocular reaction (T.O.R.) to meningococcal toxin, (3) bacterial species producing the T.O.R., (4) determination of potency, time of appearance, and duration of T.O.R., (6) effectiveness of various routes of injection, (7) detoxication of filtrates by formaldehyde, (8) potency of stored filtrates and their resistance to heat and pressure, and (9) purification by dialysis.

Protection against the ocular reaction was afforded by previous intracutaneous or intravenous injection of rabbits with Shwartzman's filtrates, or

by injections of the venom of the mocasin snake. The reaction was reproduced in cats and dogs but failed in other usual laboratory animals. T.O.R. was obtained in 95 percent of a large number of rabbits. It represents a new property of the Shwartzman toxins and indicates their marked primary toxicity for the uveal tract of the rabbit. (22 references, 2 figures, 4 tables.)

Jerome B. Thomas.

Ayo, Corrado. A toxic ocular reaction. 2. On the nature of the reaction. *Jour. of Immunology*, 1943, v. 46, March, p. 127.

The "primary aqueous" (that obtained on a first paracentesis) does not coagulate in normal rabbits but coagulation does occur in the secondary aqueous obtained by a second paracentesis closely following the first one. Upon intravenous injection of Shwartzman filtrates the primary aqueous was found to coagulate. The writer calls this the plasmoid-toxic aqueous. Various investigations described in this paper deal with the influence of Shwartzman filtrates on ciliary-body permeability, and that of washed bacterial bodies on coagulation of the primary aqueous. The studies include permeability of the ciliary body to fluorescein staining, the role of fibrinogen in coagulation of the plasmoid-toxic aqueous, and the local protective action of adrenalin against the toxic ocular reactions. The author concludes that increased permeability of the ciliary body is a major factor in the mechanism of the toxic reactions, and that the fibrinogen system plays an essential role in coagulation of the plasmoid-toxic aqueous. A retrobulbar injection of adrenalin protects the eye against the reactions. (9 references, 2 illustrations.) Jerome B. Thomas.

Bragagnola, J. Orbital neuralgia from unerupted canine teeth. *Anales Argentinos de Oft.*, 1942, v. 3, April-May-June, p. 63.

A case of severe orbital neuralgia, occurring in a 39-year-old man, did not respond to ocular therapy. Radiographic study showed an unerupted canine on the same side as the neuralgia. Extraction of the tooth brought complete relief. The author discusses the frequency, etiology, and symptomatology of the condition. Pain is caused by irritation or compression of a branch of the trigeminal.

Eugene M. Blake.

Dessoff, Joseph. The eye and related functional disturbances. *Med. Annals Dist. of Columbia*, 1943, v. 12, March, pp. 97-101.

The writer discusses some of the psychosomatic disturbances as they affect the eye. Because the sense of sight is usually the most highly regarded of all the senses it is natural that it should be the one most often disturbed by psychic influences. Presbyopes constitute a large group in which functional disturbances are common. The writer believes that neglected presbyopia is often the cause of hypochondriasis and of mild forms of melancholia. This may be due to fear of ensuing blindness or to concern over this indication of increasing age. The visual symptoms of hysteria are numerous and are often difficult to diagnose. The characteristic feature is pronounced inconsistency and variability of the visual fields. By varying the distance at which the field is taken one can bring out many discrepancies. In addition to impairment of vision hysteria may manifest itself by ptosis, spasm of lids, anesthesia of cornea and

conjunctiva, nystagmus, conjugate deviation and convergent squint, photophobia, and headaches. The ophthalmologist too often ignores the importance of eye dominance and handedness in the child's ability to learn to read. Homolateral control of eye and hand is the common rule, and contralateral control tends to create muscular and visual confusion. Some confusion in learning is suffered by many persons who are left-eyed and left-handed, but their difficulties are tremendously increased if the original left-handed status becomes converted to right-handedness by training. Word-blindness, reversal of figures, and stammering, followed by the development of behavior disorders, may occur. The earlier the pathologic phase is recognized the better for adequate treatment. The author is convinced that the relationship between blindness and insanity is much more common than is generally supposed. He briefly reviews three cases treated at St. Elizabeth's Hospital which demonstrate not only that insanity can be traced to loss of sight but that the relief of blindness by operation can restore the mental condition to normal. (2 references.)

Jerome B. Thomas.

Gómez-Márquez. Pathology in Honduras, and its relations with the prevention of blindness in that country. *Ophth. Ibero Amer.*, 1942, v. 4, no. 3, pp. 260-270 (in English, p. 271).

This paper, addressed to a general medical organization, discusses in broad terms the influence of various systemic disturbances in the production of ocular disorders.

Harley, R. D. Ocular myiasis (ophthalmomyiasis). *Amer. Jour. Ophth.*, 1943, v. 26, July, pp. 742-743.

Meillon, B. de, and Gillespie, J. C. Note on a human eye worm. *South African Med. Jour.*, 1943, v. 17, Jan. 9, pp. 5-6.

A report of a case of infestation of the human eye by a nematode, probably the first case reported in South Africa. The infestation was probably acquired in Central Africa, where the patient had resided for several years. The worm was removed from the subconjunctival tissues just above the lower fornix of the eye. It was 115 mm. long and 0.5 mm. wide. The essential factor in removal is the preparation of instruments beforehand and quickness in grasping the worm and covering tissues, and passing a suture around them. The prognosis in these cases is good, as microfilaria do not occur in human beings, and the complications resulting from them do not occur. (2 figures.) Jerome B. Thomas.

Ormsby, O. S. Dermatologic lesions about the eyes. *Amer. Jour. Ophth.*, 1943, v. 26, Aug., pp. 850-855. (References.)

Vázquez-Barrière, A. The eye in Nicolas-Favre disease. *Arch. de Oft. de Buenos Aires*, 1941, v. 16, Dec., p. 653.

The author describes the ocular findings in a series of 366 cases of lymphogranuloma or Nicolas-Favre disease. From the biomicroscopic standpoint there is a marked increase in the visibility of the corneal nerves, particularly in the pupillary area, as found by the author in 28 percent of the patients. The intraocular tension was found below normal in 79.5 percent, and not infrequently this subnormal tension was below 10 mm. Hg. There was no relation between the tonometric figures and the degree of visibility of the corneal nerves. Ophthalmoscopically, en-

gorgement and tortuosity of the retinal veins and congestion with blurring of the margins of the papilla were observed in 28.4 percent of the cases. A slight papilledema was observed at times, and a true choked disc was found in two cases, but none of the patients showed other signs of increased intracranial pressure. Tonoscopic determinations yielded rather high figures for the retinal arterial pressure, as determined with Bailliar's ophthalmodynamometer, but correct interpretation of these readings was difficult in the presence of the markedly decreased intraocular pressure found in this disease. The author concludes that lymphogranulomatosis is a systemic infection produced by a specific virus, that ocular involvement is the rule, and that the portal of entry may be in the conjunctiva. In the latter case the condition would give rise to an oculoglandular syndrome. Plinio Montalván.

## 18

### HYGIENE, SOCIOLOGY, EDUCATION, AND HISTORY

Bahn, C. A. Ophthalmic requirements of the military services. *Arch. of Ophth.*, 1943, v. 29, May, pp. 831-843.

This is a revision of the author's previous paper (*Amer. Jour. Ophth.*, 1942, v. 25, p. 1404). The complete table of material for each of the services is arranged as follows: (1) functional requirements; (2) qualifying and disqualifying conditions and diseases; (3) references for changes in ophthalmic requirements which have been issued since June, 1942.

Ralph W. Danielson.

McClung, G. W. Problems in teaching dramatics to the blind. *Outlook for the Blind*, 1943, v. 37, April, p. 95.

The importance of dramatics as part

of the teaching of the blind is discussed by the author, who heads the Department of English in the New York Institute for the Education of the Blind: Acting represents a transition from their normal activity to a land of fantasy, and allows the students to realize some of their abstract dreams. The author quotes Betty McGuire as saying, in *The Teachers' Forum* for November, 1936, that judging from her own experience and observation, the need of such self-expression is especially imperative among blind children, with their repressed emotions.

The obvious difficulties in producing plays with blind actors include the timing of action. Devices such as narrow strips of carpeting to guide the actors, and rubber mats indicating places where they are to remain stationary, are suggested. Stage furniture must of course be placed exactly.

More subtle difficulties are those of speech and pantomime. McClung uses the phrase "speaking in Braille" to characterize the monotone characteristic of the reader of Braille, who cannot see ahead how the sentence is coming out, and who cannot picture the commas and the question and exclamation marks until he comes to them, too late for guidance as to expression. Reading poetry with the instructor, the author has found, helps the student to acquire the feeling of rhythm, otherwise neglected in the concentration required for interpreting Braille.

Pantomime is most difficult detail, since from infancy the blind have not observed the language of gesture nor unconsciously absorbed facial expression. McClung has found that it usually takes the blind student three or four times as long as a seeing student to coördinate lines with action.

Suggestion and analogy he considers

more important than imitation, since the blind student can thereby achieve a naturalness of expression, but the student can also feel the lips in a smile, and learn something of what the normal actor learns through the mirror.

Dorothy Nichols.

Nair, M. A. Diseases of the visual apparatus, ancient and modern. *Jour. Indian Med. Assoc.*, 1942, v. 11, March, p. 175.

The author analyzes the descriptions of 27 diseases found in ancient Hindu literature, and compares these descriptions with modern conceptions. He is handicapped by lack of, and uncertain definitions of, ancient terminology.

R. Grunfeld.

Prado, Durval. Advice to opticians. *Arquivos Brasileiros de Oft.*, 1942, v. 5, Dec., pp. 304-306.

Brazil is said to lack an official school with a special course for the training of opticians. A number of practical considerations, as to the handling of patients and as to the filling of prescriptions, are discussed by the author.

W. H. Crisp.

Sena, J. A. Trachoma among the school children of Mendoza. *Arch. de Oft. de Buenos Aires*, 1941, v. 16, Dec., p. 674.

The article contains tables and statistical data concerning the incidence of trachoma among the school children of the province of Mendoza, Argentina. The information was compiled by the Section of Trachoma of the Department of Public Health.

Plinio Montalván.

Victoria, V. A. An attempt at classification of the clinical types of Argentinian

tine trachoma. Arch. de Oft. de Buenos Aires, 1941, v. 16, Dec., p. 680.

The author discusses MacCallan's and Fuchs's classifications of trachoma and finds them unsuitable for cataloguing the clinical forms of trachoma prevalent in Argentina, since these vary somewhat from those observed in the Middle and Far East. The writer proposes a classification as follows: 1, attenuated type, 2, nodular type, 3, infiltrative type, 4, cicatricial type.

Plinio Montalván.

## 19

### ANATOMY, EMBRYOLOGY, AND COMPARATIVE OPHTHALMOLOGY

Di Dio, J. A. D. Observations on Whitnall's orbital tubercle in the zygomatic bone of man (with investigations in vivo). Arquivos Brasileiros de Oft., 1943, v. 6, Feb., pp. 1-8.

This tiny bony prominence, about the center of the outer rim of the orbit, was present in 254 out of 285 craniums studied by the author, it being present bilaterally in 222 and unilaterally in 32. The author suggests that this anatomic detail should be recorded in treatises and atlases of anatomy. (3 illustrations.)

W. H. Crisp.

Fortin, E. P. Significance of the insertion of the oblique muscles over the macula. Arch. de Oft. de Buenos Aires, 1942, v. 17, Jan., p. 10.

According to the author, the scleral fibers have a very orderly arrangement and do not possess the irregular distribution described in the classic textbooks. Muscle fibers are found among them, in the thickness of the sclera, over the area corresponding to the insertion of the two oblique muscles. These muscle fibers penetrate deeply toward the macula, upon which they

exert definite traction. (Photomicrographs.)

Plinio Montalván.

Murray, P. D. F. The development of the conjunctival papillae and of the scleral bones in the embryo chick. Jour. of Anatomy, 1943, v. 77, April, pp. 225-240.

The development of the conjunctival papillae and of the scleral bones in the chick embryo is described in detail. The description is not suitable for abstracting.

Novah, Gerson. Contribution to the study of the anatomy of the ciliary ganglion and its connections in man. Arquivos Brasileiros de Oft., 1943, v. 6, Feb., pp. 9-12.

The author summarizes certain conclusions from his investigations on the anatomy of the ciliary ganglion and its connections in man, as set forth more extensively in his doctorate thesis (1941) before the Faculty of Medicine of the University of São Paulo, Brazil. The conclusions are in part as follows: The ciliary ganglion, seen from the side, appeared rectangular in 43 percent of the cases, and had a definitely irregular form in 32 percent. In 62 percent the lower margin of the ganglion was lower than a horizontal plane corresponding to the lower surface of the optic nerve, while in 38 percent it coincided with or was higher than this plane. The distance from the inferolateral orbital angle to the middle of the lateral face of the ganglion varied between 34 and 51 mm., and the line which represents the anterior prolongation of this distance, when projected on two imaginary lines, the first of which passes through the angles of the palpebral fissure and the second of which divides the base of the orbit into

halves (right and left), forms angles which vary respectively between 60 and 89 degrees and 58 and 85 degrees. In 9 out of 47 cases the so-called long root originated exclusively in the interior of the orbit, while in 11 out of 47 cases this root, having more than one radicle, originated partially within and partially outside the cavity. The short ciliary nerves may occasionally emerge from the lateral face of the ganglion, beyond the usual zone of emergence. No two cases, even in the same ethnic group or in the same individual, show the same morphology of the ciliary ganglion and its branches. (2 illustrations.)

W. H. Crisp.

Smeltzer, G. K. Changes induced in the Harderian gland of the guinea pig by the injection of hypophyseal extracts. *Anat. Record*, 1943, v. 86, May, pp. 41-55.

The Harderian gland, which is a large compound, apocrine gland, secreting a fatty substance, is found in the orbits of almost all mammals except the anthropoids. Injection of extracts of the anterior pituitary causes marked hypertrophy of the gland, with increase in the amount of the lipid secretion which is mainly neutral fat. In thyroidectomized animals, the response to the pituitary extract is, if anything, slightly increased. T. E. Sanders.



## CHOROIDEREMIA\*

## THE NATURE OF THE CONDITION AND CASE REPORTS

RICHARD G. SCOBEE, M.D.

Saint Louis

Choroideremia has been a bone of ophthalmologic contention ever since Mauthner<sup>1</sup> reported the first case in 1871. At the time, Mauthner was a young ophthalmologist, relatively unknown, just beginning his career. When he was confronted with such an unusual case, he quite naturally turned to the eminent Leber, already well established and prominent, for advice and consultation. It was Leber's studied opinion that the condition was one of retinitis pigmentosa with an extreme degree of choroidal atrophy. Despite the weight of Leber's opinion, Mauthner felt sure that such was not the case. He finally reported the condition as one of choroideremia, and his term has been retained to this day. That the condition is rare is indicated by the fact that there are but 26 *bona fide* cases reported in the literature to date. Six others, about whose authenticity some doubt exists, have been published. Bedell,<sup>2</sup> in 1937, wrote an excellent summary of the literature.

One may define choroideremia as a condition in which the choroid in its entirety and the retinal pigment layer eventually disappear, with a subsequent secondary atrophy of the visual elements of the retina. The visual loss is chiefly pe-

ripheral; the macular region and hence central vision are the last to suffer. Choroideremia has been confused with retinitis pigmentosa more often than with any other disease, for two reasons: first, because in both the dominant symptom is night blindness, and, second, because the present-day conception of choroideremia is not clear. On ophthalmoscopic examination the white fundus reflex of choroideremia is diagnostic, and the fundus appearance pathognomonic. Bedell believes that as it apparently develops during the life of the patient, choroideremia should not be considered as a congenital absence of the choroid but as a dissolution of that structure. The findings in the cases to be reported tend to substantiate this view. There is no ectasia of the sclera.

## CASE REPORTS

The following cases are typical of two stages of this rare condition and were therefore deemed worthwhile reporting:

CASE 1. W. S., a white man, aged 24 years, an aircraft assembly worker, was rejected for service in the U. S. Army because of poor eyesight. His vision without glasses was not sufficient to meet minimum requirements, although his corrected vision was acceptable. He was first seen in the Washington University Eye Clinic on December 28, 1942.

He stated that he had worn glasses

\* From the Washington University School of Medicine, Department of Ophthalmology, Oscar Johnson Institute. Read before the Saint Louis Ophthalmic Society, March 26, 1943.

since the age of 16 years. At the time that he got his first pair, he did not feel in any great need of them, nor did he think that they improved his distance vision greatly. In the past eight years, they have been changed five times, each time by an optometrist, and each time the lenses were made stronger. His present correction, one year old, is: O.D.,  $-4.50\text{D. sph.} \approx -1.00\text{D. cyl. ax. } 115^\circ$ , vision 6/12; O.S.,  $-4.50\text{D. sph.} \approx -0.25\text{D. cyl. ax. } 75^\circ$ , vision 6/6—. With this correction, he read Jaeger type 3 with the right eye and type 1 with the left eye.

Apart from his myopia, there were no other ocular complaints until about 13 months ago when he began to be troubled simultaneously with asthenopia and night blindness. The latter progressed in degree until at present he is almost helpless at night or in dim illumination. Although his daytime vision remained unimpaired, the asthenopia became very annoying. After only 45 minutes of steady work assembling aircraft parts, his eyes would feel tired, burn, and he would have difficulty focusing on objects across the room for from 10 to 15 seconds. There was no history of headache. Some of the optometrists who changed his glasses examined the "insides" of his eyes "with a little light" but none made any comment. His general health has been perfect, and he had only the usual diseases of childhood, prominent among which was an unusually severe attack of measles. There was no history of any trauma to head or eyes, although several years ago he fell from a fence, bruising his back; recovery from this was uneventful.

The history of his forbears revealed nothing. His parents were not related. The father died following a "heart attack" at 48 years of age; the mother is living and well at 56 years, and has no ocular complaints. The mother's fundi

show several patches of exudate on an arteriosclerotic-hypertensive basis, but no signs of choroideremia. None of the grandparents on either side had had any difficulty with their eyes. There are two sisters, aged 22 and 25 years, both healthy and without eye trouble. There are also two brothers, aged 18 and 32 years. The oldest brother has a high myopia ( $-14.50\text{D.}$  in each eye) with vision of 6/12 with correction in each eye separately. His fundi show those changes associated with moderately high myopia and no evidence of choroideremia; visual fields are normal. The youngest brother has choroideremia and will be reported as case 2.

*Physical examination* revealed nothing except a slightly elevated blood pressure (120/100) and a fast pulse (100) which may have been partially due to excitement. The Kahn test was negative, urinalysis normal, and chest plate negative.

*Ocular examination.* Vision without glasses was O.D., 2/60; O.S., 2/60. Under homatropine refraction he accepted: O.D.,  $-5.75\text{D. sph.} \approx -1.00\text{D. cyl. ax. } 115^\circ$ , vision 6/9; O.S.,  $-4.00\text{D. sph.} \approx -1.25\text{D. cyl. ax. } 75^\circ$ , vision 6/6. The eyes were externally negative, the extraocular movements being intact in all directions of gaze and with good convergence. The pupils were equal, round, regular, and reacted promptly both during accommodation and to light directly and consensually. The intraocular pressure was normal. There was orthophoria at 20 feet, four prism diopters of exophoria at 14 inches, and no vertical muscular imbalance.

Under the *slitlamp and biomicroscope*, both eyes were identical in appearance. The corneas were clear, with smooth surfaces, normal luster, no staining areas with fluorescein, and no signs of scarring. There were no keratitic precipitates

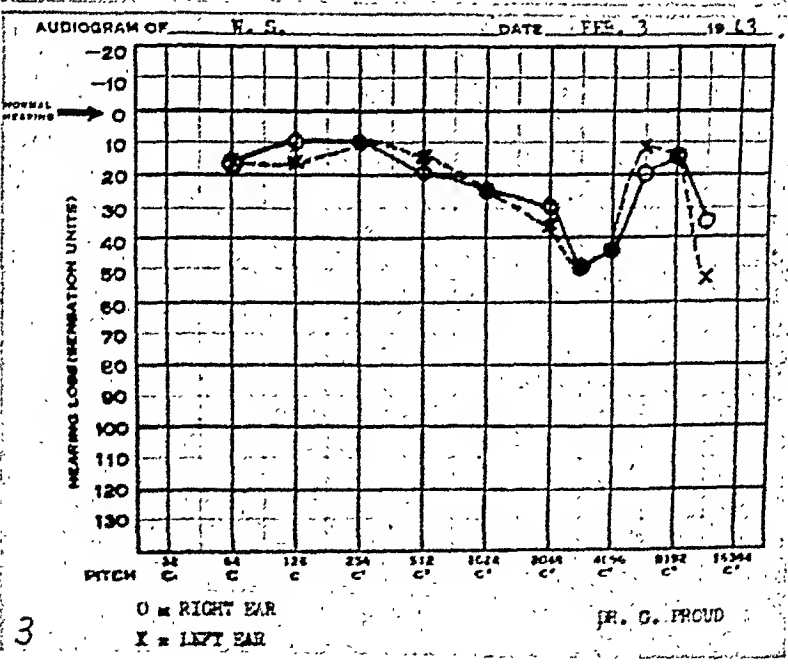
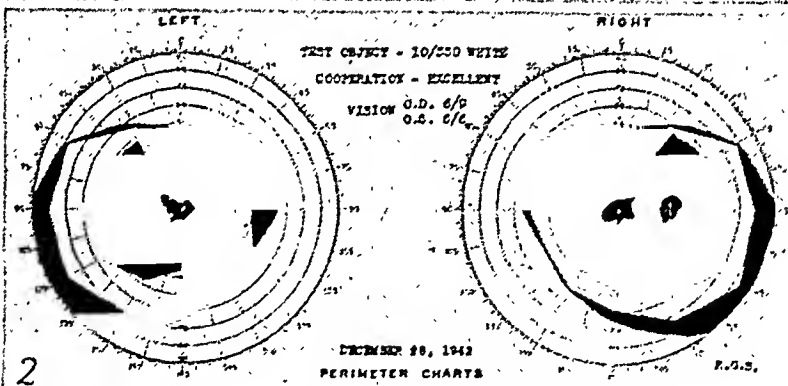
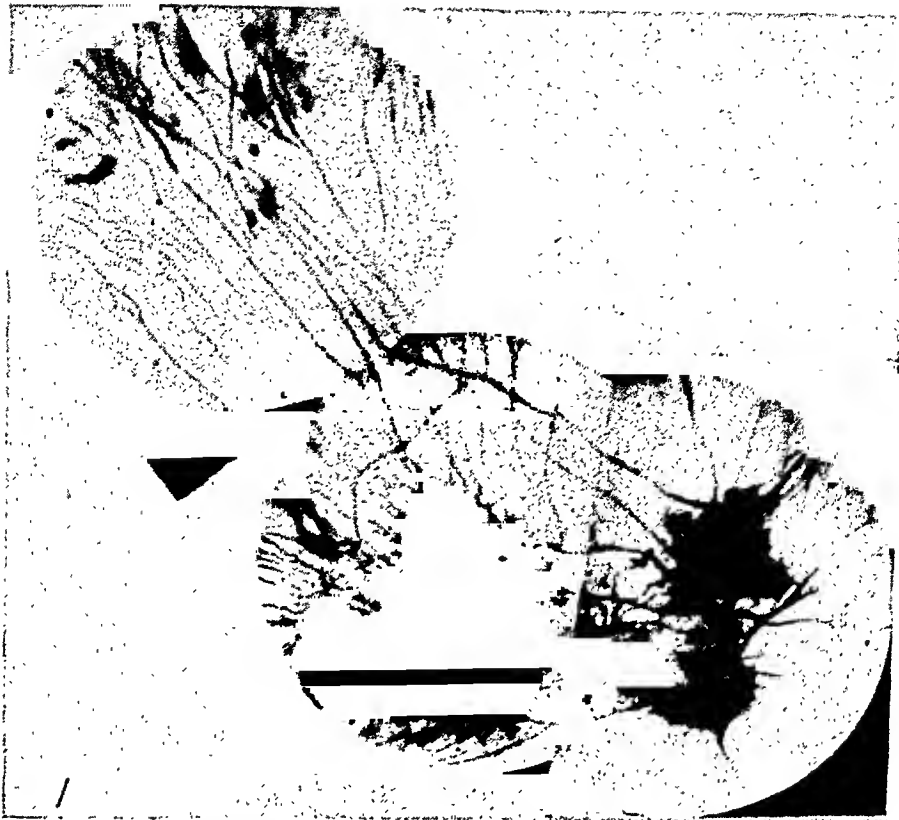
or other evidence of past inflammation in the anterior chamber. The aqueous was clear. The irides showed no sign of atrophy, the stroma appearing healthy. With widely dilated pupils, no evidences of lenticular opacity were seen in either eye.

The anterior segment of the vitreous had a most interesting appearance. Fibers arranged in irregular bundles like tangled skeins of wool which moved about with optically empty spaces between them were observed, and it was not felt that these were abnormal. However, spread throughout the limits of visibility in the vitreous were innumerable tiny brown balls of what were taken to be pigment. These tiny balls were located at the interstices of fibrils throughout the entire vitreous framework, moving slowly with movements of the eye but quickly returning to their original position. The picture resembled that of an asteroid hyalitis only in the distribution of the balls and in no other way. In support of their pigmented nature would perhaps be the fact that this was a case of pigmentary degeneration and presumably some pigment-bearing cells would be freed to wander at will through the vitreous. As stated above, no pigment was noted on the corneal endothelium.

In the most anterior part of the vitreous body, just behind the lens, some variations in the normal pseudofibers and pseudomembranes as described by Duke-Elder<sup>3</sup> were noted. There were several rather large, clearly delimited strands of so-called organized vitreous, hanging vertically and moving with an undulating motion with movements of the eyes. The peculiar thing about them was that they had a definite cross striation, reminding one of striated muscle or of a properly stained diphtheria bacillus seen under the microscope. These vitreous strands were quite difficult to make out with the oph-

thalmoscope, but were easily visible with the slitlamp.

On ophthalmoscopic examination, both eyes were identical and only one description will be given for both. The white or greenish-white fundus reflex was quite striking. No vitreous opacities were noted. The optic disc was of a normal pink color with moderate physiologic cupping and with clearly delimited margins. The retinal vascular tree appeared to be normal, or perhaps the arteries may have been very slightly narrowed. No alterations in vessel caliber or other evidences of arteriosclerosis were noted. The entire posterior half of the fundus was devoid of both retinal and choroidal pigment, except at the macula. Here, in a region about two disc diameters in size, retinal and choroidal pigment was preserved. This was obviously thinned, particularly about the edges, so that a dense underlying choroidal capillary network could be seen. No foveal reflex could be made out in the right eye. The rest of the fundus presented the glaring greenish-white color of bare sclera. Traversing the sclera radially from the disc were remnants of the posterior ciliary arteries in various stages of atrophy. Some were the size of the retinal veins while others were simply narrow brownish-red lines whose origin and destination had become obliterated. Scattered about in the equatorial region of both eyes were a very few clumps of pigment that bore no resemblance to bone corpuscles. Sparsely distributed over the posterior segment of the globe were a few knots of capillary loops, one large one being close to the disc. In the extreme periphery of the fundus, the normal red fundus reflex could be seen, although the margins were ragged and the pigment quickly faded away to blend with the generalized whiteness of the fundus posteriorly. This peripheral rim of retina and choroid could be made out every-



where save in the inferior temporal quadrant, and could be seen only with wide mydriasis (fig. 1\*).

Visual fields were taken on the tangent screen at one meter, with test objects varying in size from a 3-mm. white target to the examiner's hand. The fields had sharp margins, being constricted to about seven degrees from fixation in every direction save superiorly, where the scotoma margin approached to within three degrees of fixation. Visual fields taken on the perimeter at 330 mm. with 7 f.c. illumination and targets varying in size from a 3-mm. to a 10-mm. white test object revealed an incomplete annular scotoma with breaking through to the periphery bilaterally in the superior nasal quadrants. Peripheral-field margins were slightly contracted and the intact peripheral-field band was about 20 degrees in width (fig. 2).

*Impression:* Choroideremia, advanced, bilateral.

The patient was seen again one month later (January 30, 1943), and in the short time since his first visit, quite definite evidence of further degeneration in the right eye was observable. The area of remaining retina in the macula had developed the appearance of early cystic degeneration, especially about its periphery. In addition, the vitreous had now partially become liquefied, and many moderate-sized vitreous opacities were visible with the ophthalmoscope. Under the slitlamp, the previously mentioned pigment balls were seen to be larger, somewhat irregular, and many were no longer supported by the vitreous framework,

which itself was beginning to become disorganized. There were more and larger vitreous strands present, just posterior to the lens, and their striations were no longer apparent. Thus, definite changes had occurred within 30 days. Vision remained at 6/9 with correction in the right eye. The left eye was unchanged. The prognosis would seem particularly poor in the right eye. Audiograms revealed an early bilateral nerve-type deafness (fig. 3).

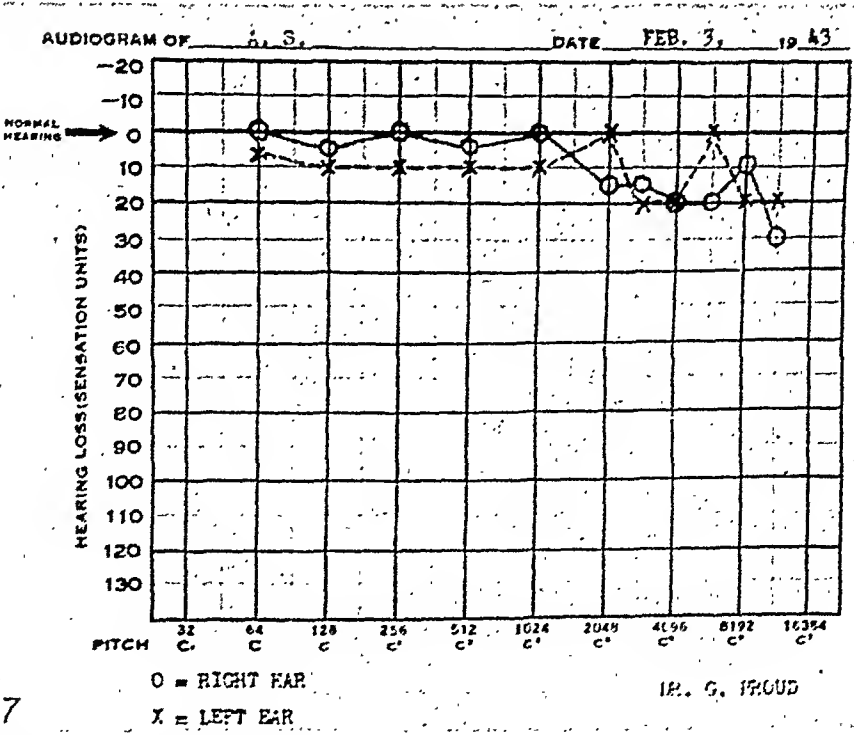
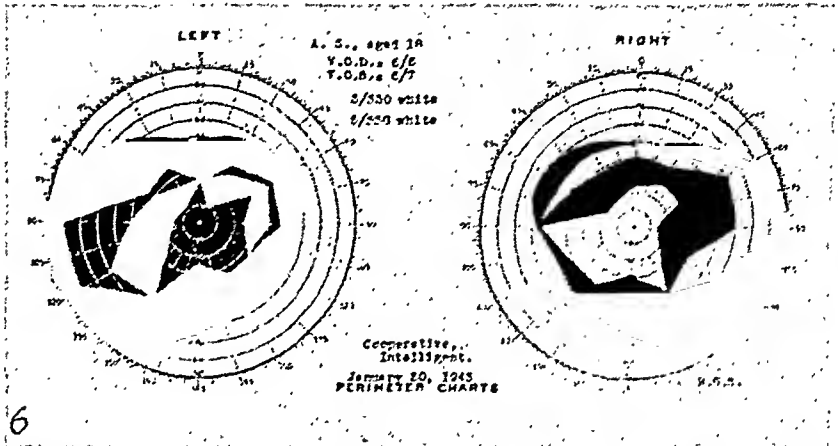
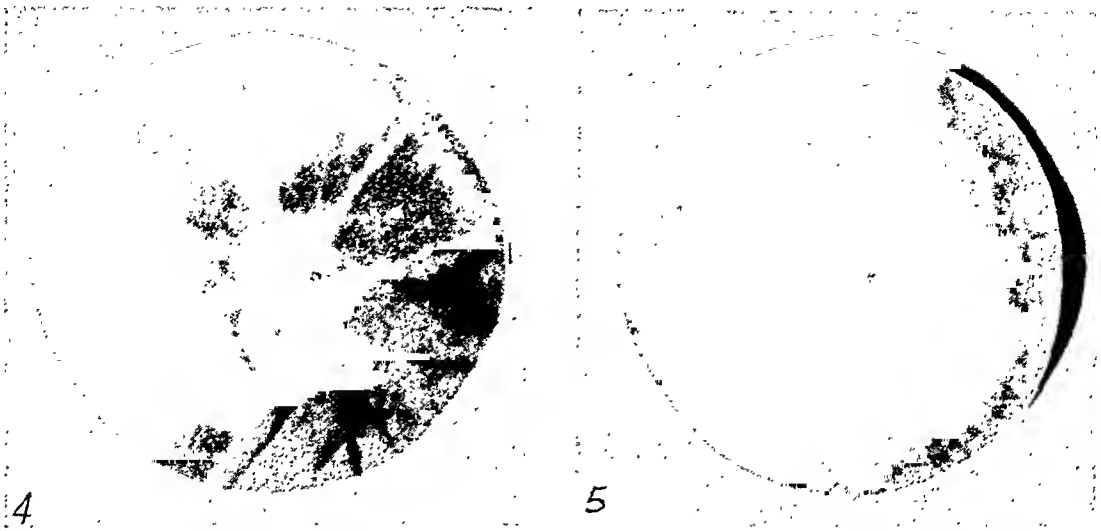
CASE 2. A. S., an 18-year-old white, male student, reported for ocular examination on request, since it had been found that his 24-year-old brother had choroideremia. He was unaware of any ocular trouble and was in perfect health. He had worn glasses for the past two years for reading only. He had always believed his vision to be normal, and had been unaware of any constriction of the visual fields, night blindness, or asthenopia.

*Physical examination* was entirely negative. Blood pressure was 130/85 and pulse rate 70. The Kahn test was negative, urinalysis negative, and the chest plate revealed nothing.

*Ocular examination.* Vision without glasses was O.D., 6/6; O.S., 6/7. Vision with glasses was O.D., 6/6; O.S., 6/6. Present correction was O.D., +0.37D. cyl. ax. 90°; O.S., +0.37D. cyl. ax. 90°. Externally the eyes were entirely negative, with normal pupillary reactions and extraocular musculature intact. Under wide mydriasis, no evidence of any lenticular changes were found, nor were there any evidences whatever of any previous intraocular inflammatory reaction. The anterior segment of the vitreous as seen with the slitlamp was entirely normal bilateral-

\* Photographs for illustrating cases 1 and 2 were taken by Mr. W. A. Moor.





Figs. 4-7 (Scobee). Case 2, Chloroideremia. 4, Fundus photograph of the disc of the right eye. 5, Fundus photograph of the macula of the right eye. 6, Perimetric fields. 7, Audiogram.

ly. Significant changes were confined to the fundi and visual fields. Only one fundus will be described, since the two were almost identical.

The optic disc was of a healthy pink color, with clear margins. The retinal vascular tree was normal in every respect. A faint greenish-white fundus reflex was noted. The retinal and choroidal pigment layers were quite definitely in what appeared to be an early stage of atrophy. Most of the small and medium-sized choroidal vessels had already become atrophic and had disappeared, whereas the remaining larger vessels were quite easily visualized through a somewhat moth-eaten retina. The entire fundus, except for the macular region, showed evidences of degenerative changes. The retina overlying the atrophic choroid, through which the greenish-white sclera was visible, made a typical picture; it reminded one of a piece of moss lying over a white rock at the bottom of a quiet pool. Only a very few clumps of pigment were noted, and again these bore no resemblance to bone corpuscles. In short, this fundus was a much earlier replica of the one described in more detail in case 1 (figs. 4 and 5).

The visual fields showed much more marked changes than might have been expected from what was apparently an early stage of the condition. On the perimeter, a marked bilateral, fairly concentric constriction of the peripheral fields was found; again the annular scotomata were present; the central fields, taken on the tangent screen, were roughly 12-degree circles (fig. 6).

Audiograms reveal an early bilateral nerve-type deafness (fig. 7).

*Progress note.* The patient was last seen on April 13, 1943, and visual fields showed progressive changes in that the incomplete annular scotoma in each eye was now a complete annular scotoma. Also, central fields showed further con-

centric contraction. The fundi appeared grossly unchanged. The field changes were evidence of a degenerative process, however, or so it would seem.

## DISCUSSION

No pathologic investigation has been made, and consequently any theory as to the origin of the condition must be speculative. Leber<sup>4</sup> suggested an association with an advanced stage of pigmentary degeneration of the retina. Connor<sup>5</sup> suggested that the first part of the capillary plexus, which ultimately forms the choroid on the outer aspect of the optic cup, appears in the region of the macula, and that therefore if the development of the mesoblast were stopped at this very early stage, immediately after differentiation had begun, choroideremia would result. A further suggestion was made by Cutler;<sup>6</sup> namely, that it represents a later stage of Fuchs's gyrate atrophy, and this has been revived more recently by Usher.<sup>7</sup>

Mann<sup>8</sup> believes that retinitis pigmentosa, Fuchs's gyrate atrophy of the choroid, choroideremia, and retinitis punctata albescens may all be atypical forms of the same condition. The type of choroideremia associated (in pedigrees) with retinitis pigmentosa she believes to be undoubtedly a secondary form of atrophy. However, she is of the opinion that occasionally sporadic cases of absence of the choroid do occur. As to the genesis of choroideremia, Mann believes it to be either (1) failure of the posterior ciliary arteries to develop, or (2) failure of the outer layer of the optic cup to produce pigment. Case 2 quite definitely disproves both of her contentions because (1) much of the choriocapillaris was still present, and (2) pigment could easily be made out in scattered remnants over the fundi.

The available evidence is still inadequate but it can be said that its congenital occurrence has never been proved. Bedell

contends that the condition is *not* a congenital absence of the choroid but its postnatal pathologic dissolution.

The two cases reported are unusual and therefore of particular interest from several standpoints.

1. According to Usher,<sup>7</sup> in 1874 König found choroideremia in two brothers; since then it has been found in brothers on only two other occasions, both times by Alexander and Wolf. This, then, is the fourth recorded instance of choroideremia in brothers.

2. Visual fields in the great majority of reported cases have shown concentric contraction. In but a very few have annular scotomata been found. In both cases here reported there were annular scotomata.

3. The eyes in over 95 percent of all recorded cases of choroideremia have been myopic. The patient in one of the two cases herein reported was hypermetropic.

4. The finding of innumerable tiny pigment balls evenly dispersed over the entire vitreous framework (case 1) has not been previously reported. That these are not of inflammatory origin seems obvious. It is more likely that they are degenerative in nature. Lending weight to this assumption is the fact of observed progressive degenerative changes in retina and vitreous in case 1, within 30 days' time.

5. The finding of an early nerve-type deafness in both cases is significant. There has long been recognized an association between retinitis pigmentosa and nerve-type deafness. Slaughter and Sirles<sup>9</sup> go into this phase of the problem more thoroughly. It occurred to me that since both retinitis pigmentosa and choroideremia are probably primary pigmentary degenerations, both should show nerve-type deafness associated in the same proportion. Examination of audiograms recorded by

Dr. O'Neil Proud revealed this to be the case. It is beyond the scope of this report to go into possible reasons for the association of nerve-type deafness with primary pigmentary degeneration, and the previously cited paper by Slaughter and Sirles does it very well.

Admittedly, no significant conclusions may be drawn from a very few cases. However, one can often find sign posts pointing the way, and then await with interest the findings of others as subsequent cases come to light. In view of findings in these two cases, the author is inclined to agree entirely with Bedell that the condition is not a congenital absence of the choroid but its postnatal pathologic dissolution.

#### SUMMARY

Two typical cases of choroideremia, one in an early and the other in a late stage, are reported in brothers aged 18 and 24 years, who lacked a hereditary background for the condition. Both have remarkably good vision in view of the fundus changes present; one is myopic, the other hypermetropic. Choroid and retina are present only at the extreme periphery and at the macula in all fundi. Their fundus reflex is greenish-white in color. Bilateral annular scotomata are present in both cases, night blindness only in the more advanced one. The more advanced case has innumerable tiny pigment balls fixed to the vitreous framework, and the anterior vitreous fibrils appear striated; degenerative changes could be observed in the vitreous picture in 30 days' time. Both patients have an early bilateral nerve-type deafness. The vitreous findings in addition to the audiographic examination would seem to furnish further evidence that choroideremia is a degenerative process primarily and not a congenital defect.

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- <sup>3</sup> Duke-Elder, W. S. Textbook of Ophthalmology. St. Louis, C. V. Mosby Co., 1940, v. 2, p. 1329.
- <sup>4</sup> Leber. Cited by Duke-Elder.<sup>3</sup>
- <sup>5</sup> Connor. Cited by Duke-Elder.<sup>3</sup>
- <sup>6</sup> Cutler. Cited by Duke-Elder.<sup>3</sup>
- <sup>7</sup> Usher, C. H. The Bowman lecture on A few hereditary eye affections. Trans. Ophth. Soc. United Kingdom, 1935, v. 55, pp. 164-245.
- <sup>8</sup> Mann, Ida. Developmental abnormalities of the eye. London, Cambridge, at the University Press, 1937, p. 196.
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## FURTHER OBSERVATIONS ON AUTOFUNDOSCOPY (AUTO-OPHTHALMOSCOPY OF EBER; PURKINJE FIGURE OF WALKER)\*

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In a previous paper, published in 1941,<sup>1</sup> I discussed at some length the accepted theory as to why the retinal blood vessels can be visualized, the methods of visualizing the retinal blood vessels, and finally the use of afterimages of known size, combined with the entoptic visualization of the retinal blood vessels in the study of central retinal lesions. It was therein pointed out that the findings raised a number of questions about retinal physiology. Nine case reports were submitted, most of which were selected to show the wide variety of conditions in which autofunduscopy combined with afterimages of known size might be useful.

### HISTORICAL

In 1825 Purkinje first described the subjective visualization of the retinal blood vessels. He mentioned three basic methods of visualization: (1) By moving a bright light focused on the sclera, pre-

erably behind the region of the ciliary body; (2) by moving a light in a circular motion close to the eye and slightly off the visual axis, while looking at a dark background; (3) by moving a stenopeic aperture held close to the eye while looking through the aperture at a bright source of light. All three methods have one common denominator: *The light thrown into the eye must be kept moving constantly.*

H. Müller, Vierordt, E. H. Weber, Helmholtz, Tscherning, Gullstrand, and many other investigators have made significant observations in studies of the entoptic images of their own retinal blood vessels. It has been accepted that the moving light throws a shadow of the perceived vessel upon rods and cones, on one side and then on the other, and that these rods and cones, being normally not so shaded, perceive the shadow. In ordinary vision the vessels are not seen because their shadows, if there are any, fall always on percipient elements which always are so shaded. This fact is easily demonstrated by holding a small ruler or a similar object a few inches from a screen. The light from a fixed pocket flashlight

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\* From the Department of Ophthalmology, Saint Louis University School of Medicine. Candidate's thesis for membership accepted by the Committee on Theses of the American Ophthalmological Society, June, 1942.

thrown upon the ruler will cast a fixed shadow; this fixed shadow could represent the shadow, if any, cast by the retinal blood vessels under normal conditions of vision. If, now, the light is moved back and forth, the shadow will, of course, also move back and forth; this condition could represent that achieved by any of the three basic methods of visualization described by Purkinje.

Helmholtz<sup>2</sup> also described as the first method of visualization Purkinje's first method. In a footnote Gullstrand<sup>2</sup> added: "The best way to make this experiment nowadays is with the illumination lamps that have been introduced into the practice of ophthalmology." Apparently Gullstrand was not impressed by the great ease with which the blood vessels could be visualized by this technique.

#### AUTOFUNDOSCOPY (AUTO-OPHTHALMOSCOPY OF EBER; PURKINJE FIGURE OF WALKER)

So far as I can discover, Eber<sup>3</sup> was the first to suggest that visualization of the fundus vessels could be useful clinically. Friedman<sup>4</sup> also suggested its use. Walker<sup>5</sup> was the first to describe definite methods and to publish the results in patients. This method of examination has never received an appropriate name. Eber called it "auto-ophthalmoscopy"; Walker termed it "Purkinje figure." Walker's name, to be sure, gives credit where it is due, and would be best, perhaps, except that Purkinje's name is attached to so many other discoveries. The term "autofunduscopy" seems to me to describe this method best, even though one cannot really see the fundus subjectively.

#### TECHNIQUE OF AUTOFUNDOSCOPY COMBINED WITH AFTERIMAGES OF KNOWN SIZE

The patient is placed in a dimly lighted or dark room. His eyes should be closed.

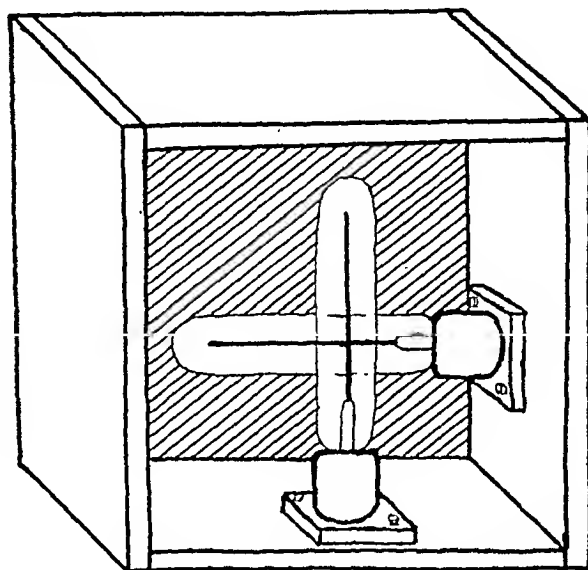
Any small bright electric lamp can be used—the ordinary pocket flashlight serves very well. The lamp is placed against the closed lower lid, pressed gently inward against the resistance of the globe through the lid, directed toward the posterior pole of the eye, and moved to and fro in any direction. If the lamp is placed against the upper lid, light may flood through the pupil and render visualization more difficult. For a few seconds most patients will see nothing but a flood of light. The exposure, if unsuccessful, should not continue for longer than one or two minutes, for if you attempt to watch your own retinal vessels longer than this they will become more and more elusive and finally fade completely. If the patient does not see the blood vessels in 20 or 30 seconds, stop and test the other eye. Once the patient has learned to see the vessels, the vascular figure will appear with startling clearness almost immediately upon exposure. A certain rhythm in the motion of the light seems to help, and at first a rapid to-and-fro movement, perhaps two to six oscillations a second, appears to bring the vascular figure into view more quickly and easily. After the patient has seen the vascular figure several times, a slow motion seems more satisfactory—perhaps one oscillation a second. By this method the patient can visualize the vascular tree quite well, especially in its central 10 to 15 degrees. This method is unlike the great majority of subjective experiments in visualization of entoptic phenomena, in which one must become expert before success is obtained. Almost any patient can succeed surprisingly well. It is true, however, that one can acquire an amazing facility in subjective visualization by practice.

However, no matter how well the patient sees his vascular tree and any retinal lesion, he has great difficulty in describing the location or approximate size of the

lesion visualized. One could, of course, let the patient face a dimly lighted screen or perimeter and visualize the lesion with the eye open, as suggested by Walker. In experiments on myself, however, before I knew of Walker's work, I decided that that would be too difficult for most patients; that this method was not easy enough to be of general clinical use. For this reason I determined to make use of afterimages of a known size and shape, although I was aware of the difficulty many trained observers have in seeing afterimages. It was, therefore, pleasant to discover that autofundoscopy produces a marked accentuation of the afterimage. Indeed, this method can be recommended in teaching any one to see afterimages, for once the afterimage is visualized, as in autofundoscopy itself, it becomes easier and easier to see the afterimage. Visualization of the vascular tree should be attempted several times until the patient becomes fairly adept before proceeding to study afterimages.

In order to produce an afterimage of definite size and proportion so as to give localization and proportion to autofundoscopy, two tubular unfrosted showcase lamps having straight single filaments were mounted in a small box at right angles to each other so that the filaments formed a cross. In order to have a ready measure of the patient's sense of proportion, the filaments were mounted excentrically, so that one arm of the cross was about twice as long as the other, as shown (see illustration, next column). The lamps are lighted and the patient is asked to look with one eye at the point where the two filaments cross. He continues to gaze there for 20 to 40 seconds, or as long as may be necessary to develop a good afterimage. The eye is then closed, and the Purkinje figure is visualized by autofundoscopy. At times the patient may have difficulty in seeing the afterimage of

the cross; here, again, after he has once seen it, repeated visualization becomes very easy. Usually the patient will see the cross almost immediately as a dark-green figure of surprising clearness, placed on the background of the delicate tracery of the foveal capillaries. If fixation was correct, the center of the crossed afterimages marks the center of the fovea. Like all



afterimages, the cross will change color and wax into view and wane, but with autofundoscopy the afterimage tends to be much more stable than it is ordinarily.

Having learned to see the blood vessels and afterimages, the patient is now asked to notice any defect in the reddish background where blood vessels or background are deficient. If there is any such defect, he is asked to note its size and position in relation to the cross, so that he may draw the defect and the cross in correct proportion. No special mention should be made about the cross being excentric; if the patient draws the cross in proper proportion, one has the assurance that he is a fairly good observer and has a sense of proportion.

By this simple technique surprisingly accurate subjective information about retinal lesions in the paracentral area has

been obtained. (For details, see the case reports in my earlier paper.)

If the retinal lesion is central, the cross should be viewed with the other, normal, eye. Autofunduscopy is then applied to the normal eye, to accentuate the afterimage. Next it is done on the abnormal eye, to visualize the retinal lesion. With a little effort most patients will soon see both the central retinal lesion of the abnormal eye by autofunduscopy and the afterimage of the normal eye. If there still is normal foveal correspondence, the afterimage across the center of the fovea of the normal eye will localize exactly the area within the scotoma in which the center of the destroyed fovea formerly was located. By this means accurate localization of the destroyed fovea is possible, and accurate mapping of the central blind spot in relation to the destroyed fovea is also possible. In ordinary field studies one is often chagrined at the wide variation in the apparent position of a central scotoma. If the patient fixates with an eye having an absolute central scotoma, he will, of course, fixate with some part of the intact excentric retina. On different occasions he may fixate with different areas of the excentric retina, thus causing a most disconcerting variability in the position of the scotoma as mapped out. If one uses the normal eye for fixation, he may be disappointed by the inconstancy of the position of the scotoma, for the muscle balance may vary considerably, and with each variation the scotoma may be found in a different position. If the muscle balance varies while the scotoma is being plotted, no constant measurement can be obtained. By the method suggested here there should be no such variations so long as normal foveal correspondence persists. How long normal foveal correspondence does persist after foveal vision is destroyed in one eye is an interesting matter for study.

#### CAUSE OF WIDENING OF THE AFTERIMAGE OF THE FILAMENT

In my previous paper it was pointed out that the afterimage of an electric light filament as seen with autofunduscopy is much broader than the image of the filament itself seemed to be. At that time it was believed that this was due either to retinal induction or to small movements of the eye. Spherical and chromatic aberration were not mentioned, because I had erroneously believed they had been ruled out. With a stenopeic opening of 1 mm., the filaments and the afterimages are equal in width, and appear to be about one third the width they seem to be with the naked eye. This effect with the stenopeic opening could be due to decreased retinal induction as a result of decreased brightness, or it could be due to decreased spherical or chromatic aberration. At any rate, small movements of the eye during fixation are thus shown to have no appreciable effect. In all my studies of afterimages my myopic correction was not used. In looking at the filament with a dark cobalt glass the filament appears as a very fine red streak, 1 mm. or less in width, surrounded by a halo of blue, 4 to 5 mm. in width. On careful comparison it is seen that with autofunduscopy the filaments appear to be about this same thickness. Therefore it seems most probable that the largest part of the apparent widening of the filaments, as seen in the afterimage, was due to chromatic aberration, and that retinal induction and small movements of the eye could account for only a very small part of it.

For patients who are unable to maintain fixation even for the few seconds required with the tubular lamps, it might be desirable to construct a double spark gap in the form of a cross. While the patient is fixating the point where the sparks will cross, the electric sparks are made

to cross the jump between the spark gaps, producing an almost instantaneous flash. If the patient had fixated correctly for just that one moment, the afterimage would certainly be centered perfectly. If used often, this method would be much more economical than illuminating a cross with photoflash lamps, and would provide an almost instantaneous flash. Whether or not the flash would be bright enough to produce a good afterimage I cannot tell.

### BINOCULAR AUTOFUNDOSCOPY

In order to study the phenomena of binocular autorefraction with an afterimage of a horizontal filament in one eye, and a simultaneous afterimage of a vertical filament in the other eye, two +8.00D. cylinders were mounted on two cardboard tubes of a length equal to the focal length of the cylinder (that is, 12.5 cm.). On looking through such a tube directed toward the naked filament of an ordinary unfrosted 100-watt electric light bulb, with the cylinder on the objective end of the tube, a very brilliant narrow streak of light is seen across the cylinder at right angles to the axis marks. It is quite noticeable that, when the cylinder is held, for example, with axis vertical, a vertical streak is focused on the cornea, but the streak is seen as horizontal. The condition can be duplicated by placing a +20.00D. sphere in the ocular end of the tube, to represent the refracting surfaces of the eye. A screen placed at the focal point of the 20.00D. lens (5 cm. from the lens) would represent the retina of an emmetropic eye of 20.00D. refraction. It is seen that when a horizontal line of light is incident on the +20.00D. sphere (or "cornea"), a vertical streak is focused on the screen (or "retina"). The two streaks may be considered to represent the first and second focal planes in Sturm's interval, in the combined system. In this

case the light brought to a focus as a line in the first plane—that is, on the surface of the lens—is to a large extent lost.

In order to get a fixation mark in the center of the streak, a thick rubber band was stretched across the end of one of the tubes coincident to the axis of the cylinder. Now, when the light is viewed with the axis vertical, a horizontal streak of light is seen with a small break about equal to the width of the rubber band in the center of the streak. Incidentally, this simple apparatus can readily take the place of a Maddox rod. If the streak of light is viewed vertically, the position of the vertical streak in relation to the light measures lateral displacement (esophoria or exophoria or esotropia or exotropia), and the position of the break in the streak in relation to the light measures vertical displacement (hyperphoria or hypotropia). We have then a "one-position screen test" to measure muscle balance. However, I believe the Maddox rod is much easier to use than this apparatus. Some skill is required to hold the tube directly toward the light so that the luminous streak covers the cylinder nearly from edge to edge. A few patients were tested with this rod of light held in one position only and the results were found to agree quite accurately with those obtained with the Maddox multiple rod. If one does not have a Maddox rod, this simple apparatus could be used in its place.

Now, one tube was held before each eye and directed toward the bright unfrosted lamp. The tube with the streak broken in its middle was used for fixation, the center of the break serving for the fixation mark. If this tube, for instance, were held before the right eye so that a vertical broken streak was seen, and the other tube were turned so that a horizontal streak was seen before the left eye, the center of the break in the vertical streak was fixated with the right

eye. In this way a vertical-streak image was formed in the right eye simultaneously with a horizontal-streak image in the left eye. Since the afterimages of these streaks are formed simultaneously, they are in phase with each other, so that they wax and wane, appear and disappear, change color and halo color together, provided the two retinas had the same pre-exposures. In orthophoria the horizontal streak will cross the vertical streak squarely, so that a perfect cross will be formed of both images and afterimages. For my purpose I was chiefly concerned with the problem of obtaining simultaneously a vertical afterimage across the fovea of, for example, the right eye, and a horizontal streak across the fovea of the left eye. When this is done with the two tubes, as previously described, and then autofunduscopy is performed on both eyes, one sees the blood vessels of each eye interlacing with one another and the cross of the afterimages squarely placed across the composite fovea of the two eyes, if the observer is orthophoric. There is no rivalry between the two fields, nor should any be expected. If, now, one discontinues autofunduscopy in the right eye, the horizontal-streak afterimage in the left eye continues dark greenish black, for the most part, whereas the afterimage of the vertical streak in the right eye tends immediately to change to a reddish color and then to go through a complex series of color changes. In some small part these color changes take place also in the left eye, on which autofunduscopy is continued, but they do not appear to be at all in the same phase as the color changes that occur in the other eye. If, now, autofunduscopy is changed to the right eye and discontinued in the left eye, the vertical afterimage in the right eye almost immediately shifts from whatever color it had been before to dark greenish black, and the afterimage

in the left eye becomes predominately reddish. Parinaud, in 1882,<sup>6</sup> from a study of color change seen in binocular afterimages, concluded that the afterimage is located in the cortex. This conclusion seems wholly unwarranted. To me the conclusion of Duke-Elder,<sup>7</sup> that the afterimage has been proved to be retinal, is open to the same general criticism. From my studies no conclusion as to the site of the afterimage—that is, whether it is retinal or cortical—seems justifiable.

After autofunduscopy is carried on for some time in even one eye alone, the blood vessels become more and more difficult to see, and the afterimage continues to fade. A short rest often will restore not only the blood vessels, but the streak afterimage. It has not been found practical to continue autofunduscopy for more than one or two minutes without re-exposure to the filaments of light. After a longer time the streaks become too variable and transient to be of value. A rest is then desirable before re-exposure.

There is no particular value in placing a stenopeic slit in the tube at the ocular or free end so as to eliminate the extra light. A sharper image of the streak will be formed, but this increase in sharpness is of no value in the tests.

#### USE OF THE CYLINDER FOR TESTING NORMAL RETINAL CORRESPONDENCE (BIELSCHOWSKY)

The tube giving rise to a streak of light broken in its middle can obviously be used to test retinal correspondence. Suppose, for example, that it is placed before the right eye so that a vertical streak is seen. The left eye is covered. The break in the streak should be fixated, and exposure continued long enough to produce a good afterimage. The tube is then placed before the left eye and rotated so that a horizontal streak is seen.

The right eye is now covered. Again the break in the center of the streak is fixated. Now, on closing both eyes, a beautiful afterimage of the streaks is seen, forming a perfect cross if the observer has normal retinal correspondence. It would seem that better visualization of the afterimages might be obtained by transferring the tube to the right and left eye several times, so that an afterimage of such a composite type might be built up that phasing would not be prominent. If only one exposure with each eye is made, it is just conceivable that when one streak is in positive phase, the other might be in negative phase, and if the phasing should happen to continue just opposite, one never could see the two streaks at the same time. Here autofunduscopy is of real value in accentuating the afterimages. Some patients have difficulty in seeing the afterimage, but usually they have no difficulty in seeing the afterimage as accentuated by autofunduscopy. After the patients see the afterimages by autofunduscopy, it is much easier for them to see the ordinary afterimages. At least, since this very simple apparatus can be used quite efficiently and with great flexibility for making this test, at least with adults, there seems to be no very good reason for obtaining a special apparatus intended for just this one purpose.

#### THE OPTIC DISC AS SEEN BY MEANS OF AUTOFUNDOSCOPY

In my previous paper it was mentioned that, with an afterimage of the crossed filaments of four degrees in size, the scotoma of the optic disc appears to be perhaps only one to two degrees in size, instead of six degrees, and is very indefinite. The blood vessels seem to run almost to a point before they are lost in an indistinct haze that appears to me to be of an elusive grayish color. Duke-Elder<sup>8</sup> mentions that, "it is of considerable im-

portance that when larger areas of stimulation are used, the contour of the afterimage is continuous across the functional blind spot." If one looks at a fixation point so chosen that the image of a long filament of light falls across the blind spot, it is readily shown that the afterimage seems to be continuous across the blind spot also. Apparently this whole phenomenon is simply another manifestation of the old well-known "filling up of the blind spot" about which so much has been written. The images of the blood vessels and the reddish background as seen by autofunduscopy, like impressions from the external world which reach to the edge of the disc, are carried in consciousness across the disc—at least, in my own case—almost to the center. By some psychologic process the blind spot is then filled up at least psychically with the same contours and backgrounds that are visualized in the retinal areas at the edge of the disc. Just how large these areas adjacent to the disc must be in order to be carried across the disc in consciousness I did not ascertain.

In measuring Mariotte's scotoma from not-visible to visible one tends to get a larger scotoma than in measuring the scotoma from visible to not-visible. I had believed that this was due to greater accuracy of fixation, but it could, at least in part, be due to a tendency to the filling up of the scotoma. The important thing is that there is no evidence that scotomas in the central 10 degrees of the field tend to be filled up by the red background or by the vessels, or that the afterimages of the streaks or filaments are continuous across them, since I have been able to measure these central scotomas with considerable accuracy with autofunduscopy, and since the scotoma, if placed properly, produces a corresponding defect in the afterimage of the filament. At least in this respect a scotoma involving the cen-



tral 10 degrees behaves differently from Mariotte's scotoma. Even in these scotomas in the central 10 to 15 degrees of the field, however, one tends to get a larger scotoma in measuring from not-visible to visible. I believe I have shown that the filling up of a central scotoma could not account for this difference in size of the scotoma, and that there is, in fact, no filling up of a central scotoma. Hopes were entertained that persons with congenital scotoma involving the central 10 degrees could be studied to learn if they behaved differently from those having an acquired scotoma, but the opportunity of studying suitable cases has not presented itself.

Duke-Elder<sup>9</sup> states that "... the disc appears entoptically as a vague gray shadow and that, on closing the eye (and stopping the exposure to light), the gray shadow changes to a bright spot and quickly fades away." I have not been able to see this, but it is very noticeable that, on exposure to a bright moving light held 15 to 20 mm. from the pupil, and 10 to 15 degrees away from the visual axis, the disc is marked by a bright light area which moves against the movement of the light. Of course, this is not the simple technique described to be used with autofunduscopy and so effective with patients, but when used on my own eyes it gives a sharper definition to the foveal blood vessels. This is simply the modern counterpart of Purkinje's third method of visualizing the fundus vessels. Purkinje looked at a bright source of light through a small moving aperture held close to the eye.

#### THE FOVEA AS SEEN WITH AUTOFUNDOSCOPY

Autofunduscopy has added nothing to our knowledge about the "entoptical fovea of Gullstrand."<sup>10</sup> As has been stated, the fine capillaries of the fovea are

better seen with Purkinje's method of visualization than with autofunduscopy.

Hess<sup>11</sup> reported that 12 to 16 minutes after 2 percent pilocarpine was dropped into the conjunctival sac of his own 50-year-old eye there was a marked decrease of foveal vision, often amounting to from one half to one third of normal. This was not due to accommodative cramp. The central four to eight letters in a line of print were seen dimly, whereas the peripheral letters were clear. Hess shows a diagram of his own normal perifoveal blood vessels, and another diagram showing complete disappearance of the same vessels under pilocarpine, with a darkening of the avascular area of the fovea as seen entoptically. After two to four minutes the entoptic picture returned to normal. This observer states that after the instillation of 1 percent pilocarpine the darkening of the fovea begins after 23 to 25 minutes and is not so striking as when 2-percent pilocarpine is used.

I have made four different attempts to observe this, but I succeeded each time only in inducing a severe ciliary cramp and sickening pain. The blood vessels of my fundus and fovea did not change perceptibly. At no time was there any evidence of central scotoma. Even when the pupil was contracted to the maximum, the blood vessels of the fovea were visualized quite well by moving a flashlight held 10 degrees below the visual line and 20 to 30 mm. from the eye. I concluded that perhaps the extreme miosis might account for Hess's entoptic findings, since he used Purkinje's third method of visualization, but it certainly does not. Perhaps older eyes react differently than do younger eyes.

When using very small objects (20 minutes) to create very small after-images, Creed and Granit<sup>12</sup> found that there is a rapid decrease in the latent period of appearance of the afterimages



in passing from fixation out to two degrees excentric. From two degrees to three degrees excentric there is a sudden increase in the latent period, suggesting transition to rod function. Using large afterimages (five degrees diameter), they found that the whole afterimage appears at the same moment no matter where it may be situated on the fundus, and with a latent period equal to that of the shortest latent period of any part of the small area covered. "Apparently the process of developing the afterimage does not need more than a start from one side in order at once to be set going all over the area previously stimulated. Since the central area can be regarded functionally as a relative blind spot in this experiment, the phenomenon is exactly comparable with filling up the normal blind spot which in normal vision has led to so much investigation and discussion."

In these experiments the whole line of the afterimage appears simultaneously, but it may fade from view somewhat irregularly.

Helmholtz<sup>13</sup> recognized that what one area of the retina perceived was conditioned to some extent upon what the adjacent areas perceived.

#### THE SIZE OF THE AFTERIMAGES FORMED BY THE CYLINDER

A +8D. cylinder, 34 mm. in diameter, held at its focal length of 125 mm. from the anterior principal focus of the eye,

corresponds to an object  $\frac{34}{125 \pi 2}$  equals 360

15 degrees approximately. The cylinder can be used in place of the linear filaments of light in measuring nearly central retinal lesions, as described in autofunduscopy. In small paracentral lesions it would be better to use a 3D. cylinder and a tube 33 cm. long so as to have about a 6-degree\* test object, since the

proportion between nearly equal-sized images is easier to observe. Thus, if the central or nearly central lesion is 3 degrees in size, the ideal after-images would be about 3 degrees in size also.

#### CASE REPORTS

*Case 1.* Mrs. L. H., a white woman, was seen April 22, 1941. A densely pigmented retinochoroidal scar slightly larger than the disc was situated about two degrees above and temporal to the fovea. With the perimeter, using a 2/350 target, a scotoma measuring 10 degrees in diameter and coming to within 3 degrees of fixation was demonstrable in the lower nasal quadrant of the central field.

With autofunduscopy the patient was unable to draw even two straight lines to form a cross, and twice placed the cross in the center of a larger dark-green scotoma. Finally, on the third trial, she drew a "kidney-bean" lesion in the lower nasal quadrant of the field, approximately five degrees in size. On two following visits, some months apart, she localized the lesion correctly in the lower nasal quadrant, but her sense of proportion was still entirely unreliable. Once she drew the lesion about 10 degrees in size and later she drew it 2 degrees in size.

This patient demonstrates the caution with which one should take the autofunduscopy finding of a supposed central scotoma in a cataract case. Her central visual acuity was normal in each eye. Her sense of proportion was about nil. Where there is no sense of proportion, one must be very patient and persistent and repeat the test a number of times before deciding that operation for cataract is not advisable, even if the presence of a central scotoma seems to be indicated by autofunduscopy.

$$\begin{array}{r} * \quad 34 \\ \hline 333 \pi 2 \\ \hline 360 \end{array}$$

*Case 2.* C. R., a freshman medical student, aged 21 years, was seen March 8, 1941. He complained of some uncertainty in reading. Ophthalmoscopically, it was observed that a large branch of the infratemporal retinal vein swung upward and passed within a degree or less on the nasal side of the fovea. With the stereocampimeter this blood vessel was readily outlined with a one-fifth degree target, only one degree from the fovea and on the right side. The patient was able to draw the vessel quite accurately with autofunduscopy.

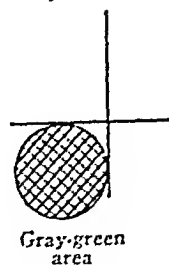
*Case 3.* L. H. D., a white man was seen August 21, 1941, for refraction. Ophthalmoscopically, a grayish retinal lesion was observed, about two disc-diameters in size and situated just above the disc. In the central zone of this lesion a very dense white oval lesion was squarely placed over the ascending nasal retinal artery, which was atretic distal to the lesion. With autofunduscopy the patient said he saw a large dark-green area starting three cross-diameters to the left and running downward and spreading ever more widely, as far down as he could see, at least six cross-diameters down. Visual-field studies showed absolute loss of the lower half of the infratemporal quadrant of the field extending up into the normal blind spot.

In my experience autofunduscopy has been somewhat unreliable with regard to lesions elsewhere than in the central field. In this particular case autofunduscopy was more reliable than I had expected.

*Case 4.* A. A., a white man, aged 50 years, was observed in January, 1942. A small round, gray-yellow choroidal lesion, about one-fifth disc-diameter in size, was found just on the temporal edge of the macula of the right eye. Using the stereocampimeter, and a 1-mm. red target, I could demonstrate no paracentral scotoma. With the Maddox rod before

the involved eye, the patient readily visualized the breaks in the rod of light just to the left of the fixation light. The central field was tested very carefully on the perimeter, with a 1/350 target, and again the scotoma could not be outlined, even though the area to the left of fixation was thoroughly explored. With autofunduscopy the patient readily drew the cross and the small lesion, measuring about one fourth of the width of the 4-degree cross, and corresponding quite well to the visible lesion.

*Case 5.* Dr. J. M., a urologist; aged 37 years, was seen April 30, 1941. While doing a cystoscopy the day before, he had noticed a purple spot before the lower temporal central field. Visual acuity was 20/20 in each eye, form fields were normal, and central fields showed no central scotoma. However, after looking at daylight the patient could himself outline a purplish spot, four degrees in size, in the infratemporal quadrant, and placed two degrees from fixation. With autofunduscopy the central fields appeared the same in each eye. Ophthalmoscopically, the macular area seemed normal. Three days later the vision had dropped to 20/30+4, and a small, dirty-yellow choroidal nodule just above and to the nasal side of the fovea was visible. With autofunduscopy the patient noticed a gray-green area, as shown here:



Again no paracentral scotoma could be demonstrated, no matter how carefully the lower temporal quadrant of the central 5 degrees was explored.

Vision never fell below 20/30+4, and

at no time was I able to measure the lesion with central-field studies although the attempt was made nine different times. The lesion could be visualized with autofunduscopy at all times, except on the first day that this was attempted. The choroidal lesion subsided and the vision returned to 20/20, but the peculiar phenomenon of seeing a purple spot in the locale of the lesion faded only very gradually, and even in December, 1941, when the patient was inducted into active service in the United States Navy, the purple spot could be visualized after exposure to very bright light. It seemed to me that the retina in this area had primarily an interference with its power of recovery after exposure to bright light. Autofunduscopy possibly merely provided the exhausting amount of light necessary to make this defect in regeneration of visual substance noticeable.

Dr. H. R. Hildreth saw this patient with me throughout the six months' period of observation. Examination with the Hildreth red-free binocular ophthalmoscope showed at most only a slight retinal edema over the very small choroidal lesion. After six months the site of the choroidal lesion was barely discernible ophthalmoscopically. The lesion showed active low-grade inflammatory symptoms for six weeks until an abscessed tooth was finally discovered and extracted, after which, within a few days, the lesion subsided.

*Case 6.* Mrs. R. R., white, was seen February 25, 1942, for refraction. Ophthalmoscopically, a jet-black choroidal lesion, one-third disc-diameter high and one-fifth disc-diameter wide, was observed very close to or in the foveal area of the right eye. The lesion was surrounded by a halo of fine depigmentation equal to  $1\frac{1}{2}$  disc-diameters. With a May ophthalmoscope giving a very small field it was found that when the patient fixated

the ophthalmoscope light an area, perhaps less than one degree below and nasal to the black choroidal lesion was centered in the field. There were no visible markings to identify it as the fovea except that the foveal blood vessels seemed to center there. Corrected vision was 20/20 in each eye, and seemed more acute in the involved right eye than in the normal left eye. No evidence of paracentral scotoma could be found with the Maddox rod, stereocampimeter, perimeter, or autofunduscopy.

With Dr. H. R. Hildreth's red-free binocular ophthalmoscope the retinal vessels overlying the choroidal lesion seemed quite normal. It was concluded that the choroidal lesion had not obliterated the choriocapillaris and had left the overlying retina intact. Very careful search for a paracentral scotoma, especially in the lower nasal quadrant of the central field, was made, because up to this time no patient with a demonstrable scotoma involving the central 10 degrees has failed to visualize it with autofunduscopy. The crux of this problem, therefore, in this case is to be as certain as possible that no paracentral scotoma is present and has been missed. Since I have found scotomas with autofunduscopy which could not be demonstrated with field studies, it does not follow that in this case the failure to demonstrate a scotoma with field tests indicates that no scotoma was present. All that can be said is that the overlying retinal vessels seemed perfectly normal, even with the red-free light, and, therefore, considering the other findings, we believe that no scotoma was present. The only acceptable proof of this, however, and that, therefore, autofunduscopy has not failed to visualize a scotoma that is actually present in the central 10 degrees of field, would be histologic examination of the retina overlying the lesion. The possibil-

ity exists, as pointed out previously, under the head, "Optic disc as seen with autofunduscopy," that a paracentral scotoma which might exhibit the same phenomenon as does the optic disc in "filling of the disc," would be overlooked with autofunduscopy.

Drs. W. E. Shahan, Carl Hobart, H. R. Hildreth, F. E. Woodruff, and M. L. Greene kindly consented to examine this patient. It was the consensus of opinion that, using the hand ophthalmoscope alone, one would conclude that foveal vision was destroyed.

### CONCLUSIONS

1. Widening of the afterimage of the filaments, as seen with my slightly myopic eye, is due chiefly to chromatic aberration.

2. An apparatus for measuring muscle balance, or for determining the presence of normal retinal correspondence can be made by simply mounting a strong plus cylinder on a paper tube of a length equal to the focal length of the cylinder and stretching a heavy rubber band across the cylinder between the axis

marks. With a second tube, similarly prepared, it is possible to study binocular afterimages simultaneously produced.

3. The decrease in size of the optic disc as seen by autofunduscopy probably is due to the "filling up of the blind spot."

4. Scotomas in the central 10 degrees of the field do not show any appreciable tendency toward "filling up," as is evidenced by accurate measurement of these scotomas by autofunduscopy.

5. Autofunduscopy requiring flooding of the eye with light may make it possible to visualize a paracentral area of the retina where retinal function is normal, except that regeneration of visual substance is delayed (case 5). This is wholly hypothetical.

6. If a scotoma in the central 10 degrees of the field did show "filling up" comparable to the filling of the scotoma of the optic nerve, it would be seen with autofunduscopy to be much smaller than it really is. Do congenital scotomas due, for instance, to coloboma of the choroid, show this?

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# INTRAVENOUS PENTOTHAL SODIUM ANESTHESIA IN OPHTHALMOLOGY\*

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Pentothal sodium was first used clinically by Lundy at the Mayo Clinic in 1934. Since that time and until March, 1942, there are reports in the literature of its use in 54,831 cases which have been summarized by Long and Ochsner.<sup>1</sup>

Pentothal sodium belongs to the group of so-called light or short-acting barbiturates. To this fact may be ascribed its success as an anesthetic agent. In contrast to nembutal and amytal, which belong to the heavy group of barbiturates and are excreted for as long as 72 hours after administration, pentothal is rapidly detoxified and eliminated. No traces of the drug can be found in body secretions in from 3 hours to 12 hours after its use.

It has been shown experimentally that the effects on the circulatory system are minimal. No significant changes have been observed in pulse volume, rate, or blood pressure. Reynolds and Veal<sup>2</sup> suggest that continuous administration may result in damage to heart muscle. Working experimentally with dogs, to which they gave repeated minimal anesthetic doses, they observed not infrequently respiratory arrest from which the animals would recover spontaneously or with the use of artificial respiration. However, when death finally occurred, it was from a sudden fall of blood pressure and not a respiratory death.

Pentothal sodium produces a definite respiratory depression clearly demonstrated by a shallowness of breathing without a change in the respiratory rate. Fortunately, the drug is destroyed so

rapidly that, even though momentary respiratory depression is evidenced, breathing usually recurs before cyanosis appears. Adriani and Rovenstine<sup>3</sup> have performed experiments which show that pentothal causes a constriction of bronchial musculature that is relieved by atropine.

Since it has been shown experimentally and clinically that respiratory depression occurs during pentothal anesthesia, it follows logically that oxygen should be administered with pentothal at all times. This is done almost universally. Another safety factor in general use is the intermittent administration of the drug in order to allow detoxification of the preceding dose before the next one is given.

In the literature there is much diverse opinion as to the usefulness of pentothal sodium. Some observers think it should be used only in short anesthetics and those not requiring marked muscular relaxation, and list asthma and decompensation as contraindications. Others have doubted that there are any contraindications and even list the so-called contraindications as actual indications for its use.

Pentothal is compatible with all the other commonly used anesthetics and can be used in conjunction with them. It is finding increasing use as a supplement to spinal anesthesia.

Another important point in addition to safety and satisfactory anesthesia is its acceptability by the patient. Numerous reports indicate that pentothal is very free from the unpleasant aftereffects commonly seen following other types of general anesthesia. Induction is rapid, varying from 10 to 15 seconds to 1 or 2 minutes, and there is no excitement during the

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second stage. Jarman and Abel<sup>4</sup> report 1,000 cases without a single case of vomiting when no preliminary medication was used. Cameron<sup>5</sup> reports 225 cases in which the only instance of vomiting followed an opiate. Not everyone reports this remarkable freedom from postoperative nausea and vomiting, but all are agreed that its incidence is much less than with any inhalation type of anesthesia.

Lorhan, Guernsey, and Rannie<sup>6</sup> report 344 surgical procedures on eye patients under pentothal anesthesia. The list includes nearly all surgical eye conditions. Detachments were performed most frequently, there being 64 in this series. Morphine and atropine were used preoperatively in nearly all their patients. It is interesting to note that sneezing during induction developed in 7 out of 21 patients who had a barbiturate without morphine preoperatively, and also in 4 out of 19 patients who had no preoperative medication. Forty-four of their patients had nausea and vomiting on the first postoperative day. Nausea alone was present in 16 patients. These authors conclude that pentothal is a very satisfactory anesthetic for eye patients.

There is considerable discussion about using pentothal in children, but all authorities are agreed that it is contraindicated in the very young. The main reasons for this as summarized by Lamb<sup>7</sup> are that children, having a higher metabolic rate, require relatively larger doses than do adults and this could easily result in an overdose, especially since the reaction to barbiturates in the very young is quite uncertain. Also the narrow airway in small children presents a further difficulty in the adequate administration of oxygen should an overdose of pentothal be given. Technically the smaller veins and poor coöperation found in this age group add further complications. Lamb advises that the lowest age limit at which

pentothal can be safely used is 9 or 10 years. The age of the youngest child on which it has been used in Barnes Hospital is 7 years. The youngest patient on whom an eye operation was performed under pentothal (in the series to follow) was 10 years old.

The accompanying tables give statistical data on 94 patients who underwent 106 eye operations under pentothal anesthesia. This series includes all the eye cases on which this type of anesthesia has been used in Barnes Hospital since April, 1942.

The type of preoperative medication with but few exceptions has been an opiate and atropine. Atropine alone or with mebutal was used a few times and in a few cases no preoperative medication was used.

The types of operations performed include 27 enucleations and eviscerations; 17 detachments; 15 squints; 12 cataracts; 11 glaucoma operations; 3 each of plastic repair and intraocular foreign body; 2 each of conjunctival flap, tear sac, retrobulbar alcohol injection, and ptosis; and 1 each of traumatic repair, cyclodialysis, oulectomy, exenteration of orbit, dermoid cyst of orbit, secondary wound closure (cataract), and iris prolapse. In three instances the operations were cancelled after induction of anesthesia.

This series includes in addition to the private and ward patients operated on by the authors and the resident staff, other private cases of Dr. B. Y. Alvis, Dr. M. H. Post, Dr. William M. James, Dr. H. R. Hildreth, and Dr. T. E. Sanders. These men kindly permitted us to use their cases in this report.

Sneezing during induction of anesthesia was encountered a few times. This complication is not recorded on the hospital charts, so its frequency cannot be accurately stated, but it was not found often and its occurrence did not complicate the

TABLE 1  
DATA ON 106 OPERATIONS UNDER PENTOTHAL SODIUM ANESTHESIA

Patient	Operation	Preoperative Medication	Duration of Operation	Amount of Pentothal Used	Blood Pressure during Operation		Postoperative Nausea and Vomiting
					High	Low	
1. E. C.	Cataract extraction	dilaudid gr. 1/48 at. gr. 1/150	45 min.	15 grs.	150 80	120 80	none
2. A. W.	For retinal detachment	dilaudid gr. 1/64 at. gr. 1/150	55 min.	17 grs.	150 80	120 80	nauseated vomited next a.m.
3. J. H.	For retinal detachment	dilaudid gr. 1/48 at. gr. 1/150	30 min.	7.5 grs.	180 120	130 80	none
4. G. R.	Enucleation	morphine gr. 1/4 at. gr. 1/150	1 hour	23 grs.	140 80	130 80	none
5. D. W.	Dermoid cyst of orbit	none	1 hr. 50 min.	30 grs.	145 90	115 80	vomited next a.m.
6. E. B.	Secondary wound closure	nembutal gr. iii at. gr. 1/150	40 min.	10 grs.	190 100	110 80	none
7 L. W.	Enucleation	dilaudid gr. 1/32 at. gr. 1/150	30 min.	17.7 grs.	220 120	160 90	vomited once
8. L. G.	Ptosis	dilaudid gr. 1/64 at. gr. 1/200	1 hr. 15 min.	19.4 grs.	130 80	110 80	none
9. J. H.	Evisceration	atropine gr. 1/150	20 min.	amount not recorded	160 100	150 80	vomited twice
10. M. H.	Enucleation	dilaudid gr. 1/48 at. gr. 1/150	20 min.	7.5 grs.	230 110	130 110	none
11. C. M.	Exenteration of orbit	morphine gr. 1/4 at. gr. 1/150	1 hr. 15 min.	21.8 grs.	230 130	180 90	vomited next p.m.
12. R. M.	Strabismus correction	nembutal gr. iii	55 min.	31 grs.	175 120	145 90	vomited 6 times
13. A. K.	Cataract extraction	nembutal gr. iii at. gr. 1/150	20 min.	15.5 grs.	130 80	120 70	none
14. B. H.	Trephine	dilaudid gr. 1/48 at. gr. 1/150	25 min.	11.6 grs.	160 70	110 60	none
15. J. S.	Strabismus correction	dilaudid gr. 1/32 at. gr. 1/500	25 min.	14.5 grs.	160 90	126 58	none
16. J. H.	Evisceration	atropine gr. 1/150	20 min.	7 grs.	230 130	200 120	none
17. T. A.	Strabismus correction	dilaudid gr. 1/40 at. gr. 1/150	40 min.	7.5 grs.	140 90	130 80	nauseated vomited once
18. G. W.	For retinal detachment	dilaudid gr. 1/40	25 min.	9.6 grs.	160 100	150 90	none
19. G. W.	For retinal detachment	dilaudid gr. 1/40 at. gr. 1/150	30 min.	15.5 grs.	200 120	160 110	none
20. F. Z.	Barkan extraction	dilaudid gr. 1/32 at. gr. 1/150	25 min.	16.8 grs.	160 108	148 100	none
21. B. S.	Trephine	dilaudid gr. 1/48 at. gr. 1/150	25 min.	5.5 grs.	160 100	130 80	none

TABLE 1—Continued

Patient	Operation	Preoperative Medication	Duration of Operation	Amount of Pentothal Used	Blood Pressure during Operation		Postoperative Nausea and Vomiting
					High	Low	
22. L. C.	Cataract extraction	dilaudid gr. 1/48 at. gr. 1/150	35 min.	5 grs.	180 120	165 100	none
23. J. M.	Trephine	dilaudid gr. 1/48 at. gr. 1/150	40 min.	10.8 grs.	120 70	100 70	none
24. T. S.	Iridencleisis and excision of secondary membrane	dilaudid gr. 1/48 at. gr. 1/150	50 min.	13.5 grs.	120 70	115 65	none
25. B. T.	Intraocular foreign body and cataract extraction	nembutal gr. iii at. gr. 1/150	1 hr. 20 min.	22 grs.	130 85	160 65	none
26. A. P.	Trephine	dilaudid gr. 1/48 at. gr. 1/150	30 min.	9 grs.	120 50	110 60	none
27. H. D.	Strabismus correction	dilaudid gr. 1/32 at. gr. 1/150	40 min.	21.1 grs.	135 80	100 60	vomited twice
28. C. F.	Strabismus correction	dilaudid gr. 1/32 at. gr. 1/150	25 min.	8.9 grs.	165 100	165 90	none
29. F. E.	For retinal detachment	dilaudid gr. 1/32 at. gr. 1/150	30 min.	5 grs.	140 80	110 80	vomited 3 times after eating ice cream on return to room
30. H. N.	Iridencleisis	dilaudid gr. 1/32 at. gr. 1/150	30 min.	10 grs.	130 80	110 70	none
31. H. N.	Trephine	dilaudid gr. 1/32 at. gr. 1/150	30 min.	7 grs.	160 80	120 70	none
32. L. M.	Strabismus correction	dilaudid gr. 1/32 at. gr. 1/150	40 min.	12 grs.	135 80	110 75	none
33. J. B.	Strabismus correction	dilaudid gr. 1/48 at. gr. 1/150	45 min.	21 grs.	130 50	120 50	none
34. S. F.	For retinal detachment	dilaudid gr. 1/48 at. gr. 1/150	20 min.	11.6 grs.	140 100	130 80	none
35. L. C.	Tear-sac extirpation	dilaudid gr. 1/32 at. gr. 1/150	20 min.	7.5 grs.	170 110	140 100	none
36. L. C.	Cataract extraction	dilaudid gr. 1/48 at. gr. 1/150	35 min.	7.5 grs.	146 100	136 92	none
37. J. F.	Cataract extraction	dilaudid gr. 1/48 at. gr. 1/150	30 min.	6 grs.	110 55	80 40	vomited next day
38. A. M.	Operation cancelled after induction	dilaudid gr. 1/48 at. gr. 1/150	15 min.	7.7 grs.	180 100	160 100	none
39. A. M.	Cataract extraction	dilaudid gr. 1/48 at. gr. 1/150	30 min.	9.6 grs.	150 70	120 50	none
40. G. W.	Cataract extraction	dilaudid gr. 1/48 at. gr. 1/150	25 min.	10 grs.	140 90	125 80	none
41. E. O.	Removal of intraocular foreign body	dilaudid gr. 1/32 at. gr. 1/150	1 hour	18 grs.	130 80	120 80	none
42. R. P.	Plastic repair	dilaudid gr. 1/32 at. gr. 1/150	55 min.	7.5 grs.	130 90	116 80	none
43. H. C.	Retrobulbar alcohol injection	dilaudid gr. 1/32 at. gr. 1/150	10 min.	3.3 grs.	160 90	146 82	none



TABLE 1—Continued

Patient	Operation	Preoperative Medication	Duration of Operation	Amount of Pentothal Used	Blood Pressure during Operation		Postoperative Nausea and Vomiting
					High	Low	
44. R. W.	Cataract extraction	dilaudid gr. 1/48 at. gr. 1/150	30 min.	9.0 grs.	<u>160</u> 94	<u>118</u> 78	none
45. J. S.	Strabismus correction	dilaudid gr. 1/48 at. gr. 1/150	25 min.	14.2 grs.	<u>160</u> 90	<u>126</u> 58	none
46. F. S.	For retinal detachment	dilaudid gr. 1/32 at. gr. 1/150	40 min.	10.3 grs.	<u>148</u> 100	<u>117</u> 80	vomited twice
47. M. B.	Cataract extraction	at. gr. 1/150	25 min.	21.1 grs.	<u>140</u> 80	<u>120</u> 70	vomited 2d postoperative day
48. A. P.	Iridenceleisis	nembutal gr. iii at. gr. 1/150	25 min.	10.7 grs.	<u>110</u> 60	<u>100</u> 60	none
49. B. S.	Trephine	at. gr. 1/150	15 min.	7.5 grs.	<u>142</u> 80	<u>140</u> 80	none
50. G. M.	Enucleation	dilaudid gr. 1/32 at. gr. 1/150	25 min.	19.0 grs.	<u>170</u> 110	<u>150</u> 108	none
51. C. B.	Enucleation	dilaudid gr. 1/48 at. gr. 1/150	25 min.	12.2 grs.	<u>200</u> 99	<u>150</u> 80	vomited once
52. A. M.	Cataract extraction	dilaudid gr. 1/64 at. gr. 1/150	45 min.	9.0 grs.	<u>134</u> 84	<u>90</u> 60	none
53. F. S.	For retinal detachment	nembutal gr. iii at. gr. 1/150	30 min.	11.5 grs.	<u>150</u> 100	<u>140</u> 90	none
54. M. L.	Conjunctival flap	at. gr. 1/150	20 min.	9.6 grs.	<u>162</u> 100	<u>152</u> 100	none
55. T. S.	Enucleation	at. gr. 1/150	25 min.	not recorded	<u>150</u> 100	<u>120</u> 72	none
56. M. R.	For retinal detachment	at. gr. 1/150	45 min.	25.0 grs.	<u>140</u> 100	<u>114</u> 82	vomited 2d postoperative day
57. H. H.	Iris prolapse	pantopon gr. 1/3 at. gr. 1/150	45 min.	18.0 grs.	<u>100</u> 70	<u>100</u> 70	none
58. R. S.	Extirpation of tear sac	at. gr. 1/150	40 min.	28.0 grs.	<u>140</u> 100	<u>114</u> 80	vomited once
59. H. N.	Evisceration	hyoscine gr. 1/120 pantopon gr. 1/3	30 min.	14.0 grs.	<u>180</u> 110	<u>140</u> 90	none
60. C. R.	Enucleation	dilaudid gr. 1/32 at. gr. 1/150	30 min.	12.0 grs.	<u>104</u> 78	<u>96</u> 68	none
61. O. N.	Conjunctival flap	at. gr. 1/150	40 min.	28.5 grs.	<u>118</u> 70	<u>104</u> 70	none
62. A. S.	Enucleation	dilaudid gr. 1/32 at. gr. 1/150	40 min.	14.7 grs.	<u>180</u> 102	<u>150</u> 86	none
63. M. V.	Strabismus correction	dilaudid gr. 1/32 at. gr. 1/150	5 min.	5.9 grs.	<u>120</u> 88	<u>108</u> 80	none
64. A. E.	Enucleation	dilaudid gr. 1/32 at. gr. 1/150	40 min.	10.0 grs.	<u>164</u> 100	<u>150</u> 88	none

TABLE 1—Continued

Patient	Operation	Preoperative Medication	Duration of Operation	Amount of Pentothal Used	Blood Pressure during Operation		Postoperative Nausea and Vomiting
					High	Low	
65. J. T.	Enucleation	dilaudid gr. 1/32 at. gr. 1/150	25 min.	14.7 grs.	$\frac{180}{120}$	$\frac{150}{96}$	none
66. A. B.	For retinal detachment	at. gr. 1/150	25 min.	15.0 grs.	$\frac{190}{110}$	$\frac{140}{80}$	none
67. H. B.	For retinal detachment	dilaudid gr. 1/32 at. gr. 1/150	1 hr. 15 min.	36.6 grs.	$\frac{170}{110}$	$\frac{120}{80}$	none
68. R. S.	Strabismus correction	phenobarbital gr. 1½ at. gr. 1/200	25 min.	23.0 grs.	$\frac{150}{100}$	$\frac{144}{90}$	none
69. S. F.	Enucleation	at. gr. 1/150	25 min.	19.2 grs.	$\frac{116}{74}$	$\frac{100}{60}$	none
70. H. B.	Enucleation	dilaudid gr. 1/32 at. gr. 1/150	35 min.	15.9 grs.	$\frac{184}{118}$	$\frac{168}{108}$	none
71. H. C.	For retinal detachment	dilaudid gr. 1/32 at. gr. 1/150	35 min.	28.5 grs.	$\frac{120}{86}$	$\frac{116}{84}$	none
72. A. L.	Iridenceleisis	dilaudid gr. 1/48 at. gr. 1/150	20 min.	3.1 grs.	$\frac{150}{70}$	$\frac{140}{68}$	none
73. M. H.	Strabismus correction	dilaudid gr. 1/32 at. gr. 1/150	35 min.	12.5 grs.	not	recorded	none
74. F. Z.	Cataract extraction	dilaudid gr. 1/32 at. gr. 1/150	25 min.	15.0 grs.	$\frac{124}{70}$	$\frac{118}{68}$	none
75. A. L.	Iridenceleisis	dilaudid gr. 1/48 at. gr. 1/150	25 min.	7.0 grs.	$\frac{160}{90}$	$\frac{150}{80}$	none
76. J. R.	Operation cancelled	at. gr. 1/150	10 min.	10.7 grs.	$\frac{140}{100}$	$\frac{130}{90}$	none
77. O. V.	Enucleation	dilaudid gr. 1/32 at. gr. 1/150	15 min.	8.0 grs.	$\frac{140}{90}$	$\frac{120}{80}$	none
78. R. B.	Traumatic repair	dilaudid gr. 1/32 at. gr. 1/150	25 min.	8.0 grs.	$\frac{146}{80}$	$\frac{130}{70}$	none
79. J. K.	Plastic	dilaudid gr. 1/32 at. gr. 1/150	1 hr. 30 min.	32.0 grs.	$\frac{140}{100}$	$\frac{116}{80}$	vomited next p.m.
80. T. G.	Strabismus correction	dilaudid gr. 1/32 at. gr. 1/150	35 min.	16.0 grs.	$\frac{140}{90}$	$\frac{120}{70}$	none
81. A. H.	Alcohol injection	dilaudid gr. 1/32 at. gr. 1/150	10 min.	1.8 grs.	$\frac{200}{90}$	$\frac{200}{94}$	none
82. E. H.	Enucleation	dilaudid gr. 1/32 at. gr. 1/150	25 min.	6.2 grs.	$\frac{220}{150}$	$\frac{124}{78}$	none
83. S. G.	Enucleation	dilaudid gr. 1/32	15 min.	9.6 grs.	$\frac{140}{90}$	$\frac{140}{80}$	none
84. H. V.	For retinal detachment	dilaudid gr. 1/32 at. gr. 1/250	30 min.	13.5 grs.	$\frac{170}{100}$	$\frac{150}{100}$	none
85. I. H.	Cyclodiathermy	dilaudid gr. 1/32 at. gr. 1/150	50 min.	7.0 grs.	$\frac{190}{120}$	$\frac{112}{78}$	vomited twice

TABLE 1—Continued

Patient	Operation	Preoperative Medication	Duration of Operation	Amount of Pentothal Used	Blood Pressure during Operation		Postoperative Nausea and Vomiting
					High	Low	
86. L. G.	Ptosis	dilaudid gr. 1/32 at. gr. 1/150	40 min.	12.0 grs.	150 100	130 90	vomited once
87. T. B.	Enucleation	dilaudid gr. 1/32 at. gr. 1/150	20 min.	13.9 grs.	150 106	140 80	none
88. A. H.	Enucleation	dilaudid gr. 1/32 at. gr. 1/150	25 min.	10.8 grs.	236 140	190 110	none
89. L. M.	Enucleation	dilaudid gr. 1/32 at. gr. 1/150	35 min.	18.0 grs.	160 100	130 80	none
90. E. H.	Strabismus correction	dilaudid gr. 1/32 at. gr. 1/150	30 min.	9.7 grs.	140 80	120 68	none
91. R. R.	Removal of intra-ocular foreign body	dilaudid gr. 1/32 at. gr. 1/150	40 min.	10.8 grs.	180 100	160 100	none
92. H. V.	For retinal detachment	dilaudid gr. 1/32 at. gr. 1/150	50 min.	7.0 grs.	140 80	110 70	none
93. R. S.	Evisceration	dilaudid gr. 1/32 at. gr. 1/150	10 min.	8.2 grs.	88 70	88 70	vomited once
94. J. K.	Enucleation	dilaudid gr. 1/32 at. gr. 1/150	20 min.	15.5 grs.	150 90	120 80	none
95. R. S.	Enucleation	dilaudid gr. 1/32 at. gr. 1/150	25 min.	8.8 grs.	206 100	198 98	vomited twice
96. N. S.	For retinal detachment	dilaudid gr. 1/32 at. gr. 1/150	45 min.	15.5 grs.	170 104	128 70	vomited once
97. F. M.	Enucleation	dilaudid gr. 1/32 at. gr. 1/150	20 min.	10.8 grs.	160 110	128 90	none
98. E. G.	For retinal detachment	dilaudid gr. 1/32 at. gr. 1/150	25 min.	10.9 grs.	150 90	128 86	none
99. J. K.	Evisceration	dilaudid gr. 1/32 at. gr. 1/150	35 min.	11.6 grs.	140 80	120 60	vomited once
100. V. M.	Plastic	dilaudid gr. 1/32 at. gr. 1/150	50 min.	17.2 grs.	136 100	124 76	vomited next a.m.
101. H. N.	Oulectomy	dilaudid gr. 1/32 at. gr. 1/150	20 min.	12.0 grs.	180 120	170 110	none
102. Y. H.	For retinal detachment	dilaudid gr. 1/32 at. gr. 1/150	55 min.	20.9 grs.	146 90	120 80	none
103. C. I.	Strabismus correction	dilaudid gr. 1/32 at. gr. 1/150	45 min.	16.3 grs.	120 80	110 78	vomited once
104. M. B.	Strabismus correction	dilaudid gr. 1/32 at. gr. 1/150	30 min.	16.5 grs.	130 80	124 80	vomited once
105. L. W.	Enucleation	morphine sul- phate gr. 1/6	20 min.	5.0 grs.	180 120	180 108	none
106. J. B.	Operation cancelled	dilaudid gr. 1/48 at. gr. 1/150	10 min.	5.1 grs.	170 90	156 90	none

operation, as it never occurred after induction was complete.

In the vast majority of these cases the regular local anesthesia ordinarily employed for any given procedure was also used. In cataract surgery particularly—but this applies to all intraocular surgery—in addition to instillation anesthesia, the usual subconjunctival cocaine and epinephrine injection and the Van Lint facial akinesia were used. There are two advantages to be gained from this procedure. In the first place, it is felt that by reducing painful stimuli during the operation the patient is carried along with a lesser amount of pentothal; and, second, the orbicularis paralysis should last beyond the time that the patient fully reacts so that there will be no involuntary squeezing during the awakening period.

The length of time the patients were under anesthesia varied from 5 minutes to 1 hour and 50 minutes with an average time for all cases of 34 minutes. The Department of Anesthesia in Barnes Hospital advise against the use of pentothal in cases of hypertension. As mentioned earlier in this paper, this view is not universally held. In this series there were 10 patients whose systolic pressure was 200 or over prior to surgery or during anesthesia. In two instances where the pressure was 200—prior to operation there was no significant change during operation. In three patients who had normal pressure prior to operation the blood pressure rose to 200 or over. The other five patients had mild to moderate hypertension preoperatively, and all these showed a definite elevation of from 30 mm. to 80 mm. of mercury during operation. However, there were no instances of cardiac collapse in these 10 patients, nor in any of the rest of the group. There were several other patients with less marked hypertension who showed no significant variation in blood pressure. From

the preceding facts no definite conclusions can be drawn as to whether or not pentothal is contraindicated in hypertension, but certainly no harm can be done to inject a word of caution about its use in these patients.

The only serious complication encountered was a temporary apnea which occurred twice. In the first instance the patient was a 24-year-old, healthy, colored boy. The patient stopped breathing after he had been asleep 10 minutes. By the use of artificial respiration and coramine, breathing was reestablished in a few minutes. The heart action remained good throughout. The next day the patient seemed none the worse for his experience. The second instance occurred in a healthy, 64-year-old, white man. He also stopped breathing 10 minutes after induction and rallied satisfactorily with respiratory stimulants. The operation (enucleation) was subsequently performed three days later under local anesthesia, with no other complications.

The relaxation of the patient was satisfactory in all but one case. This was an operation for strabismus on a husky, 20-year-old, red-headed boy. After the internus muscle had been recessed with the patient not well relaxed, it was decided to continue the operation under ether and nitrous oxide.

In all these cases pentothal was used in a 2.5-percent solution both for the induction and for subsequent doses. The amount of drugs used was recorded in all but two cases. In the others the amount varied from 1.8 gr. to 36.3 gr., with an average for all cases of 14.18 gr. Generally speaking, it can be said for this series that the younger and more vigorous patients required relatively larger amounts of pentothal for anesthesia. Long and Ochsner<sup>1</sup> also made mention of this, stating that the muscular component of the patient to a large extent determined the

amount of drug which is used.

There were 17 patients who vomited on the evening following operation. There were eight more who vomited on the next day or later; however, because of the rapidity with which the drug is eliminated from the body, it does not seem likely that the vomiting in the last eight patients could have been caused by the pentothal. Fourteen of the 17 patients who vomited within a few hours after operation had received an opiate preoperatively; two received atropine only and one had nembutal only. There is some controversy concerning the use of an opiate preoperatively, but most investigators subscribe to its use. Our Department of Anesthesia is among this latter group, that being the reason opiates were used so consistently in this series. However, due to the fact that 14 out of the 17 patients who vomited had had an opiate and the extreme hazard this might cause following intraocular surgery, the authors are of the opinion that the use of opiates preoperatively could well be dispensed with.

Satisfactory anesthesia has been obtained in several instances in this series without the use of an opiate.

In conclusion it would be well to add that none of the patients with whom the authors had contact thought the induction was in any way unpleasant. In fact, most of them were agreeably surprised at the rapidity and ease with which they went to sleep and the remarkable freedom from the unpleasant aftereffects so commonly experienced following inhalation anesthesia. The authors feel, as do the other men whose cases are herein reported, that these anesthetics in almost every instance were eminently satisfactory from the standpoint of both the patient and the surgeon.

#### SUMMARY

A brief review of the literature on pentothal sodium anesthesia is presented along with statistical data on 106 operations performed on eye patients in Barnes Hospital under this type of anesthesia. Following this is a discussion of the data.

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# A SURVEY OF THE STATE OF OPHTHALMOLOGY IN PHILADELPHIA AT THE TIME OF THE FOUNDING OF THE SECTION ON OPHTHALMOLOGY AT THE COLLEGE OF PHYSICIANS

A PERSONAL CONTRIBUTION TO THE CELEBRATION OF THE 50TH  
ANNIVERSARY OF THE SECTION, APRIL 3, 1943

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The Section on Ophthalmology of the College of Physicians of Philadelphia, through the members, has served the community, the city, the state, the nation, and the world. No one attending the Section in the past 25 years would believe that the College debated for three years or more before consenting to the creation of a "Section"; yet, the American Ophthalmological Society had been in existence since 1864, and, a "Section" of the American Medical Association had been active since 1878!

One may consider several reasons for the unwillingness of the Fellows to consent to the establishment of such a dividing of the interests of the College. There was, throughout the profession in Philadelphia, a reluctance to allow specializing in medicine. Most practitioners prided themselves on their ability to attend to any case brought to their doors. Of the 15 Fellows who signed the petition for the formation of this "Section," 8 were in the general practice of either medicine or surgery, and they undertook ophthalmic cases as matters of course. D. Hayes Agnew was Professor of Surgery at the University; Gwilym Davis, surgeon at two or more hospitals and systematically undertaking orthopedic patients; Hunt, surgeon at the Pennsylvania, and so was T. G. Morton. George Piersol was devoting himself to anatomy; John B. Roberts was seeking to advance his skill in plastic surgery; Augustus Wilson operating on joints and tendons, emerging into mod-

ern orthopedics, and so, also, was J. K. Young. Notwithstanding, all these well-known Fellows treated eye cases. Last year there was presented at the Ophthalmological Society the trial-lens frame used by Professor Gross! I have the remains of G. C. Davis's case of eye instruments; some ophthalmologic works from Morton's library, and Augustus Wilson's copy of Soelberg Wells's "Treatise on the diseases of the eye."

It was feared that the would-be "specialist" Fellows might form a separate organization; so, when, at last, permission was granted, it was with the expressed proviso that a new "society" should not be constituted. The lower committee-room at the Thirteenth and Locust Streets' end of the first floor of the old building was assigned to them. There, in that dingy room, lined with stuffed book cases with locked doors, several wooden benches were provided. Sessions were held on the third Thursday of the month from November to May. Of course, I was *not* in at the beginning; the first meeting I attended was on the 16th of December, 1895. Dr. Norris was the chairman. In time I became acquainted with all the original members certain of whom were later my dear and revered friends, and from them I learned of the early days of the Section.

It should be interesting to recall what brought the Fellows together. It was felt that ophthalmic subjects ought to be given deeper and closer attention than was

possible by those who, in the course of one 24 hours might, in the morning, "have set a fractured knee-joint; reduced a femoral hernia at noon; excised a breast after lunch; fitted an old man with reading glasses; and operated for cataract later in the day" (Dr. Davis once reported to me that he had had such a day's work)—or, when at a meeting of the College, one, occupied with ophthalmic subjects, attempted to gain attention from the assembled Fellows on the "Absolute static refraction of the eye" (the title of a paper by Dr. Jackson).

At last the Section got under way, and the meetings began to be attended by Fellows and invited members of the profession. Definite programs were arranged and rare and useful cases presented—both for exhibition and to show the results of treatment. Papers were read setting forth in scholarly manner the results of the essayists' own contributions or the summary of others' research. In all the 50 years there has never been a meeting passed nor a wholly uninteresting program offered.

Most of the early members, at one time or another, had been associated at Wills Hospital, as surgeons or clinical assistants. Their desire for the establishment of the Section can be well understood, and it was by their devotion to the science and practice of the "specialty" that "the Philadelphia School of Ophthalmology" brought fame to the city.

A glance at the programs of the years 1890 to 1893 would show us the topics with which they were engaged. I have had deep admiration of the efforts of those men. What industry! How crude, we might declare, were their "instruments of precision!"

Antisepsis of the eye was uncertain and confused. The bichloride and other compounds of mercury were employed in varying degrees of strength—some, alas,

in escharotic proportions. In serious and prolonged operations general anesthesia was employed; chloroform was still in use. Was it not in 1884 that Köller had found cocaine capable of ensuring complete local anesthesia? Bacteriology was cautiously advancing the truths of its findings.

Much, in those early days, was attended to in the patients' homes.

While all hospitals maintained "Eye Dispensaries," the patients were regarded as "Out-Patients." When indoor treatment was required, in order to admit the patient permission to place the patient in his ward had to be obtained from the general medical or surgical member on duty. Dr. Norris informed me that for some years he maintained, at his own expense, an "Eye Ward" at the University Hospital. Elsewhere the patients occupied beds in the wards—and the eye man was regarded almost with sufferance. At the hospital where I was resident the attending surgeon, who, one day, arrived some time after the ophthalmologist, objected strongly because I had begun to make "rounds" of the eye patients then in his general ward.

Ophthalmoscopes were being invented, modified, and improved by the score; the difficulties of using them satisfactorily were great; and the literature relating to ophthalmoscopes was so voluminous that many a would-be ophthalmologist gave up in despair of ever becoming expert in their use.

General practitioners in those days knew some things—cataract and glaucoma and iritis, as well as "bloodshot eyes" and "conjunctivitis"—and deemed themselves capable of caring for all such patients. Perhaps some would send defective-sighted patients to "Queen's" or to "McAlister's" for a pair of spectacles. Astigmatism was regarded as an ultra refinement of the "eye-man," who, it was some-

times said, was only assuming it to be an actual defect. Risley and Randall had only recently published the reports of their laborious and painstaking examination of the eyes of the children in the public schools.

Something was known about choked disc and albuminuric retinitis; such cases, it was likely, came under notice only late in the course of the disease. Too many were skeptical of the opinion that the condition might be diagnosed and the affected one's life preserved by early and repeated exploration with the ophthalmoscope. In their minds, intraocular signs of cardiovascular disease were still questionable; however, the abnormal findings in the choroid and retina associated with such disorders were studied with increased attention. The helpfulness of the ophthalmologist, shown towards his colleagues in charge of the case, stands as one of the benefits of specialism in medicine. Dr. Norris told me that for several years after his return from his course in Europe he visited the medical wards at the Pennsylvania Hospital every Sunday to study the eyegrounds of the patients bedfast there. Imagine the difficulties—a candle, or a smoking portable lamp, and a reflecting ophthalmoscope!

Ophthalmia, a generic term, was employed in speaking of conjunctivitis, which existed in many clinical forms, acute and chronic, in all degrees of severity and consequences. Except for the *Gonococcus*, no special organism had yet been isolated to explain the causes of the several varieties. Diphtheria not infrequently invaded and destroyed the eyes.

Blennorrhoea in adults and the newborn, the gonorrheal conjunctivitis of later days, was not by all regarded as dependent on the *diplococcus* of Neisser. It was likely to be called "purulent ophthalmia"; the dire consequences of the

disease were looked upon frequently as inevitable. Patients were as likely to be found in the practice among the well-to-do and others, as in the service of midwives in the poorer sections. The list of remedies was legion, despite Credé's teachings and direction. The young victims crowded the schools for the blind.

There were no immigration restrictions—thousands of trachomatous persons went through the city, regardless of their contagiousness.

The only criterion accepted in presumed syphilitic disease was the "therapeutic test"; namely, after specific medication, the regression and ceasing of observable symptoms. It took many years for Hutchinson's dictum of 1866 to be accepted that recurring "interstitial keratitis" was an expression of inherited syphilis. When the deformed permanent teeth appeared the doubtfulness was likely to be less; and, when the child's hearing became dull, the observer might strip the child and detect osseous signs of the malady.

It was recorded at the period we are recalling that disease of the choroid and retina was, alas, too frequently the result of syphilitic infection, congenital or acquired. Again, we today must remember there were no means but the clinical manifestations by which to obtain a diagnosis of syphilis.

Affections of the tear passages resisted, *from the time of Percivall Pott*, probing, slitting, and syringing, until the radical extirpation of the sac was perfected. Does anyone nowadays see a ruptured lacrimal abscess with its noisome fistula?

Infectious effusions from the sac, not previously pronouncedly apparent, frequently caused loss of the eye after cataract and other incision operations. Few then imagined how damaging affections of the sinuses adjacent to and connected with the orbit might become.



Erosions of the cornea and abscesses, as well as inflammations of deeper layers, obstinately refused to heal. At that period it was observed that incidence as well as healing depended on sufficient diet, and that by reorganization of the dietary to provide nutritive elements—such elements as are now known as “vitamins”—favored recovery and permanent healing.

All the acute infectious fevers—measles, scarlet fever, diphtheria, smallpox, cerebrospinal meningitis—especially during epidemics, presented more or less ocular symptoms. In prolonged convalescence from these diseases, which in the 90's were more common than since that period, serious conditions not infrequently followed, as in the case of tuberculosis after measles. How frequently in those 1890 years were children, the victims of scrofulous ophthalmia, brought to the clinics with phlyctenular diseases of the conjunctiva and cornea—an affection almost never seen today! In the report of the Wills Hospital for 1894, 243 cases affecting the conjunctiva and 207 of the cornea were recorded.

The diagnosis of glaucoma engaged many an earnest observer. The mysteries of its causation perplexed them, exhausting their ingenuity. More and more was the general system studied to inquire whether or not the eye might express the state of the general health. Commonly, premonitory stages were seldom accurately observed. If surgical measures were not immediately indicated, miotics being used, certain observers were so highly impressed by the effectiveness of these alkaloids that, when an attack was believed to be impending, the persistent employment of pilocarpine or eserine was noted to have defended the eye from an outburst. Such ideas as these agitated the minds of all. Reliance rested on iridectomy chiefly; yet paracentesis of the

cornea and sclerotomy were constantly practiced by certain operators. It was noticed, however, that not all eyes were helped; indeed, some were made worse by iridectomy and other operations. Confusion existed with regard to cases not glaucomatous, as to the origin of excavation of the nerve head so exactly resembling the cupping in glaucoma—distinguishing essential atrophy of the optic nerve from simple chronic glaucoma.

Osler and other inquiring minds of influence in those days, insisting on the examination of the ocular fundus, brought to attention the changed pictures dependent upon blood dyscrasias, as in anemia, polycythemia, leucocythemia, as well as those of pronounced, and then well-known, signs of albuminuric retinitis. Frequently what seemed to be a normal fundus, with no signs of exudations or atrophy, exhibited marked alterations in the vascular systems; the vessels might have lost the wavy outline, being more or less straight in their course and so stiff as to press more or less deeply, indenting the underlying accompanying vessel, perhaps with interruption of the blood columns.

Probably no ophthalmoscopic study yielded in the ensuing years such results as this field, so ably begun and here pursued by Dr. de Schweinitz, for we learned that those more or less minute alterations presaged the gross manifestations of disease noted in the early days of the use of the mirror.

Diabetic patients were encountered frequently during this period, their condition commonly so far advanced as to include cataract, and the general manifestations contraindicating extraction. There were also states of general health accompanied by low grades of uveitis, considered to be the result of what was deemed an “auto-intoxication,” the term being rather broadly used; yet it was thought that the

state of health depended on the faulty action of the intestinal glands. Some observers, however, began to examine into the state of the teeth and the tonsils, disease of which they believed could affect the whole system; and it was noted that when such faucial maladies were made healthy, the general health improved and the ocular symptoms lessened, if they did not disappear completely. It is impossible for us to praise sufficiently those who insisted on the removal of the dental and faucial pathologic entities. In this connection, many patients were classed as gouty or rheumatic.

Cataract absorbed the minds and attention of all. Any discussion at the Section was quite likely to be animated, sometimes acrimonious. "Should one operate *early* before the cataract had become ripe?" "Should one attempt measures to hasten ripeness?" "Should the operation be 'simple,' or should one always perform iridectomy in combination, or preliminary?" "Dare one remove the entire lens without lacerating the capsule? Leave particles of the cortex, or, flush them with sterile water from a syringe?" And, "How should the eye be dressed? Simply light pieces of gauze and cotton; or isin-glass? Or, with a wide flannel figure-of-8 roller bandage?" During the adjustment of the "figure-of-8" eyes sometimes were destroyed.

That dreadful malady, sympathetic ophthalmia, was frequently reported. Much speculation existed as to its origin—"were infectious products carried to the sympathizing eye by the blood stream?" or, "Was it the result of reflex action through the ciliary nerves?" or, "Were microorganisms circulating within the sheaths of the optic nerves?" Some observers classed it as a "migratory ophthalmitis." It was indeed a speculative subject.

The proposal for a Section received

great support from Weir Mitchell whose influence, in all that pertained to the advance of medicine, was progressing in power and extent. He continued his membership for years, and, through his collaboration, subjects relating to neurology soon began to be offered for discussions at the meetings. The operation of the Infirmary of Nervous Diseases—the old Orthopedic at Seventeenth and Summer Streets—began to attract several among those whose conception of the function of the ophthalmologist included the observance of signs of abnormality in the ocular nervous responses associated with the disorders manifested in the cerebrospinal system, in addition to the well-defined signs of oculomotor pareses. The debt owing to ophthalmology by neurology is still recognized. Was it not Hughlings Jackson who declared that he owed his success in the study and comprehension of neurologic considerations to his having been an ophthalmologist in his early years?

And this aspect of ophthalmology was directly associated with the signs of weakness of the ocular muscles in the classification of the functional disorders of the extraocular muscles, in large measure dependent upon faulty structure or inequalities in length or strength, producing derangement of "the external muscle balance." All the signs were comprehended under the term heterophoria with the divisions exophoria, esophoria, and so on, introduced by Stevens—terms distinctive and exact in their designation of the conditions.

The subject of the movements of the eyeballs and their anomalies was assuming an importance far greater than ever before. No longer was it only internal "squinting" that received attention; each muscle was found to give its own symptoms and to combine with the symptoms elicited from all the others. Not only was simple complete tenotomy, chiefly of the

internal rectus muscle, performed, but each of the others was tenotomized partially or completely, and the opposing muscle advanced to a degree to assure parallelism in position and unity of function; if needed, the two operations were combined. In all cases efforts were made to reduce the accompanying amblyopia so commonly found in such squinting eyes; not only was the cosmetic effect sought but the visual strength ascertained and developed.

So intimately were muscular insufficiencies or heterophorias connected with evidences of ametropia that no case of hyperopia or myopia could be properly studied without due attention being given to the symptoms apparent or elicited from the state of the muscles moving the globe.

Refraction was regarded in some quarters rather lightly. The farsighted were given plus spheres and the nearsighted minus. Astigmatism of one diopter or more was attended to, but partial amounts might not be corrected unless distinct symptoms demanded glasses. It was not long after 1890 that it became known that the most painful cases of eyestrain were relieved by cylinders of less than one diopter, in one twentieths or one forty-eighths. Trial-lens cases contained few of fractional measures above the equivalent of 3D. At the University Dispensary the lenses were marked "inches, French," which necessitated, at the writing of each of the orders sent to the optician, the calculation into "diopters" by myself or my fellow-assistant.

Refraction by means of the shadow test or retinoscopy, or, as Dr. Jackson called it, "Skiascopy," was being depended upon more and more in the hands of an increasing number of observers.

The necessity of prescribing the full measures of the defects, both hyperopic and myopic was often caustically dis-

cussed. And, "Just how much should be withheld in such partial corrections?" Also, "Should glasses be worn constantly?"

Along with problems connected with refraction was considered that of the propriety of using in all cases what was spoken of as a "mydriatic," in reality, a "cyclopegic." Few then were hardy enough to advocate their use in adult eyes. Atropia was the first to be employed, but as the effects of belladonna seldom passed off under a week or ten days, other effective, quick-acting alkaloïds were sought, and homatropine, dubosia, hyoscine, hyoscyamine were the substitutes used experimentally.

In the study of excised tissues, the methods, both gross and histologic, were only those of the general pathologist. It was soon demonstrated, however, that the delicate elements required other methods to bring out minute details.

The influence of the Section soon became manifest. The papers and reports presented at the meetings were published in the general journals and in Knapp's Archives, founded in 1869; in the Ophthalmic Record, 1891; and in the American Journal of Ophthalmology, 1894. They were accepted, in whole, or in part, or in abstracts, by European journals. Of signal importance was the issue, in 1893, by Dr. de Schweinitz, of "Diseases of the eye," "a handbook of ophthalmic practice"—an epitome of the accepted teaching at the time of the founding of the Section.

This is but a superficial and desultory survey of the status of ophthalmology of the period when the Section was founded. Much has been omitted: the improvements in operative surgical procedures, the removal of foreign bodies in the globe, traumatisms, the increasing usefulness of the perimeter, and therapeutics can only be mentioned.

The last decade of the 19th century was the end of what might be called the "period of clinical intuition," during which much was accomplished by the men and women engaged therein, although only by their mechanically unaided powers. The examination of the eye and its functions had been almost solely by the in-

dividual's powers of observation, but, from then on, by the invention of precision instruments and the developing of intense laboratory experimentation, the founders of the Section, their successors, and their guests carried the Section to the forefront of American medicine.

*317 South Fifteenth Street.*

## X-RAY THERAPY OF INFLAMMATORY AND NEOPLASTIC DISEASES OF THE EYE\*

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### GENERAL

In considering the treatment of ocular diseases with X rays it should be borne in mind that the eye does not consist of a single tissue but of a number of tissues reacting to X rays in a varying manner. Most of these tissues are found also outside the eye, and their radiosensitivity is well known. The hair of the brows and lashes reacts to X rays no differently from hair in other regions. The skin of the eyelids reacts like the skin of the surrounding face or neck. The reaction of the conjunctiva resembles closely that of the mucous membrane of the lips or the cheek. The retina responds to the rays like the brain. The cornea is essentially a modified squamous epithelium and reacts to X rays accordingly.

The lens is the only tissue peculiar to the eye and consequently the only one in which radiation causes effects not encountered in any other tissue. This effect consists of an opacification of the lens. It can be understood when we recall that irradiation causes an increased permea-

bility through the walls of the cells. Therefore a perivascular edema results when a capillary is irradiated because an increased amount of blood plasma passes through the walls into the surrounding tissues. In contrast to the capillary, the lens has a solid center and is suspended in an aqueous medium. Consequently, fluid passes from the neighboring vitreous substance into the solid lens. This process takes place on the posterior surface because the capsule surrounding the lens is much thinner there than at the equator and on the anterior surface. As a result of the imbibition by the lens of an increased amount of fluid it becomes swollen and gradually more and more opaque.

The fact that damage to the lens is a radiation effect peculiar to the eye does not, however, imply that the lens is particularly sensitive to X rays. On the contrary, it does not possess any of the characteristics of a radiosensitive tissue, such as a great regenerative or metabolic activity. As a matter of fact, the lens belongs to the more radio resistant parts of the eye. It is much less sensitive than the cornea, the eyelid, or the conjunctiva, the last named being apparently the most radiosensitive tissue of the eye. The rea-

\*From the Department of Radiology, New York University, Medical College. Condensed from a lecture given in the postgraduate course for ophthalmologists on April 22, 1943.

son why, nonetheless, the lens is considered radiosensitive is that once damaged by X rays, the injury, as a rule, is permanent; usually a slowly progressing effect results until the lens has to be removed. In contrast, damage to the other parts of the eye is generally not permanent but frequently of only temporary character, such as dermatitis, conjunctivitis, keratitis.

In so far as possible all undesirable reactions are to be avoided—those of a permanent as well as those of a transitory nature. And it may be said that it appears much easier to avoid ray damage to the eye than, for instance, to the testicles, ovaries, or blood-forming tissues. Ocular protection is provided in the following way:

I. If the lesion is in the neighborhood of, but outside, the eyes the latter are covered with lead, according to the general principles of protection from rays.

II. If the lesion is in the eye itself, one must distinguish whether the lesion is in front of the cornea or behind it.

(1) If the lesion is in front of the cornea: (a) Only unfiltered or slightly filtered rays are used. (b) The ray beam is directed, if possible, either tangentially or from some other angle, so that it does not traverse the cornea. (c) An eyeshield made of gold or glass with a layer of lead is inserted into the conjunctival sac, where it lies like a contact glass during the treatment.

(2) If the lesion is behind the cornea, the only effective measure is to reduce the amount of the single dose.

This measure applies to all tissues of the body. It is known that if, for example, an erythema dose is not given in one application but in divided doses, the total amount of radiation energy can be increased because recovery takes place in the interval between the irradiations. It is furthermore known that the recovery factor varies inversely to the sensitivity

of the tissues and that, accordingly, it is more pronounced in normal than in pathologic conditions. All in all—in the eye as in other tissues—safety is increased if the fractional method is used; that is to say, if the single dose is small.

In a general way it may be said that of the two main groups of lesions amenable to X-ray therapy, the inflammatory and neoplastic, the former as a rule require very small doses, whereas tumors require very large ones. Accordingly, inflammatory lesions of all parts of the eye can be treated with X rays without causing a permanent or even temporary damage to the normal structures. In so far as the tumors are concerned, a temporary reaction can rarely be avoided, whereas permanent damage can be prevented if they are located in front of the cornea, because the measures of protection, herein before discussed, can then be applied. In tumors situated behind the cornea, permanent damage, either to the entire bulb or part of it, such as cornea, lens, or retina, can never be ruled out, although it may not be invariable, if the fractioned method is properly applied.

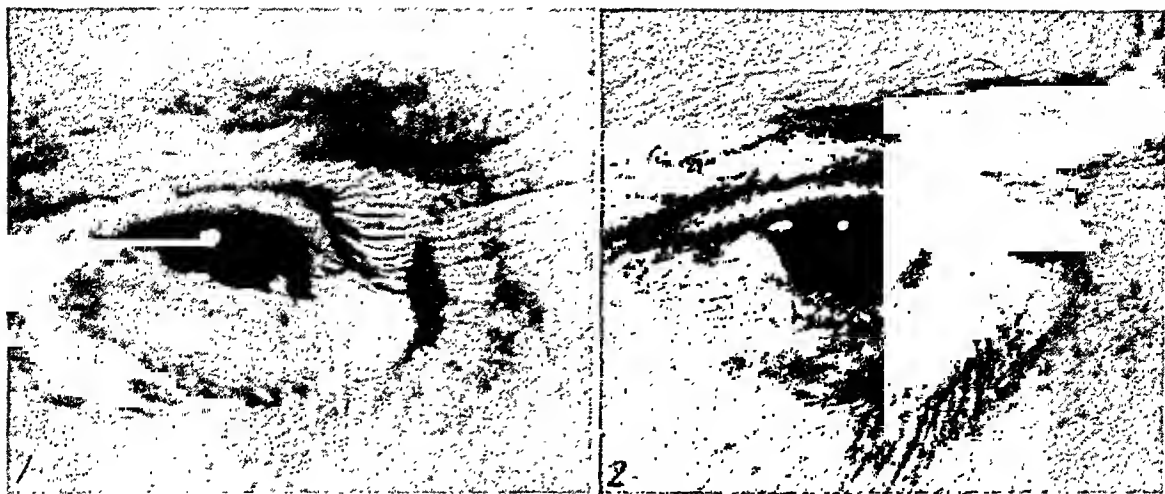
#### SPECIFIC

In inflammatory conditions of an acute character the single dose is 50 to 100 r, the interval between the irradiations two to four days, the number of treatments one to four.

In inflammatory conditions of a chronic character the single dose is 150 to 200 r, the interval between the irradiations four to eight days, the number of treatments two to six.

In tumors of lymphatic origin the single dose is 300 to 400 r, the interval between the irradiations two to four days, the number of treatments four to eight.

For tumors of epithelial origin (basal-cell carcinomas) the single dose is 400 to 600 r, the interval between the irradiations



Figs. 1 and 2 (Borak). Figure 1, chalazion of three months' duration. Figure 2, same patient after three doses, 150 r each, at four days' intervals.



Figs. 3 and 4 (Borak). Figure 3, acute dacryoadenitis. Figure 4, same patient, two days after a single treatment with 100 r.



Figs. 5 and 6 (Borak). Figure 5, keratitis with hypopyon following an injury. Figure 6, same patient, 17 days after four irradiations with 100 r each at three days' intervals.



Figs. 7 and 8 (Borak). Figure 7, epithelioma of the eyelid, inner angle. Figure 8, same patient after a single irradiation with 1,500 r.



Figs. 9 and 10 (Borak). Figure 9, lymphosarcoma of the eye as a part manifestation of a generalized condition. Figure 10, same patient, two weeks after 2 irradiations with 300 r each.

tions one to four days, the number of treatments 6 to 12. If the cancer is very small, a single irradiation with 1,500 r can be applied.

In tumors of other origin the same procedure is followed, but the number of

treatments is usually larger, depending on the response to the treatment.

#### LESIONS AMENABLE TO X-RAY THERAPY INFLAMMATORY CONDITIONS

EYEBROWS. *Sycosis*: Temporary X-ray

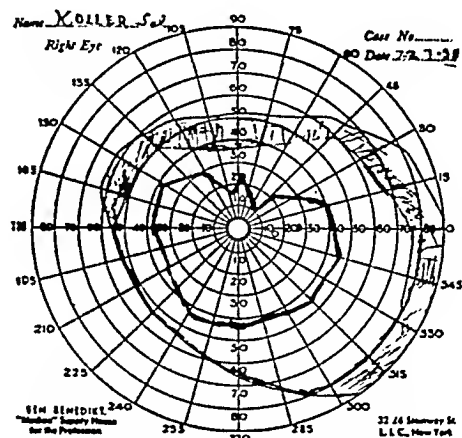
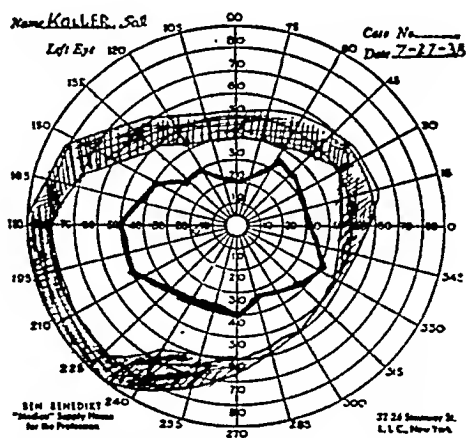
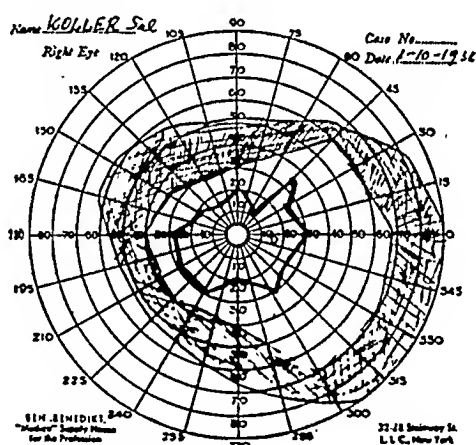
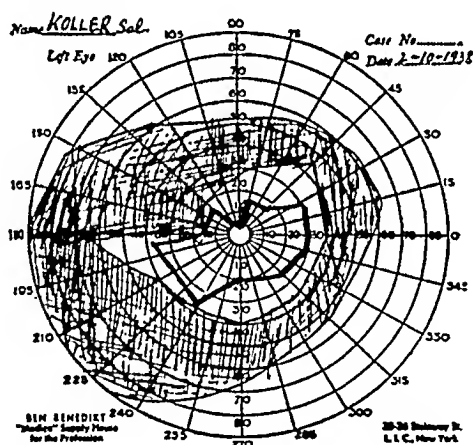


Fig. 11 (Borak). Pituitary tumor. Visual fields before the treatment (upper row) and five months later following three courses of deep X-ray therapy (lower row).



epilation brings about definite cure.

**EYELIDS.** *Hordeolum*: A sty, similar to a furuncle of any other localization. It disappears in a very short time without any additional treatment.

*Chalazion*: Very sensitive to rays so that surgical intervention becomes unnecessary (see figs. 1 and 2).

*Blepharitis*: Responds like eczema of the skin; that is, it can be improved even in very obstinate cases, although it may recur.

**CONJUNCTIVA.** X-ray therapy has proved effective in the follicular type, in conjunctivitis of vernal origin, in tuberculosis, and in trachoma.

**LACRIMAL APPARATUS.** X-ray therapy has proved very effective in acute adenocystitis and dacryocystitis (see figs. 3 and 4).

**CORNEA.** Ulcers—for example, serpent ulcer, following a trauma—clear up very quickly, also if associated with hypopyon (see figs. 5 and 6). Keratitis of eczematous, tuberculous, and interstitial character react more slowly.

**IRIS, CILIARY BODY, AND CHOROID.** Tuberculosis can be cured in the earlier, proliferative stage and can be improved even in more advanced stages. Rheumatoid and posttraumatic iritis can also be influenced.

**GLAUCOMA.** In the absolute stage the pain can often be relieved.

#### NEOPLASTIC DISEASES

**EYELIDS.** Basal-cell cancers are usually cured with an excellent cosmetic result (see figs. 7 and 8).

*Lymphadenoma*, arising from the lymphatic tissue around the lacrimal gland, is extremely radiosensitive (see figs. 9 and 10).

*Hemangioma*: The strawberry type can be successfully treated.

**INTRAOCCULAR TUMORS.** *Sarcomas*: Those of anaplastic structure are very sensitive.

*Retinoblastoma*: Can be arrested for many years, occasionally completely destroyed.

**RETROBULAR TUMORS.** Some malignant tumors are sometimes sensitive.

**INTRACRANIAL TUMORS.** Pituitary adenoma can be definitely improved (see fig. 11).

**METASTASES TO THE EYE.** These are found in the eyelids and retrobulbarly in generalized lymphosarcomatosis and carcinosis. The former respond to X rays readily, the latter depending on the sensitivity of the primary tumors.

667 Madison Avenue.



# THE PARENTS' ROLE IN ORTHOPTIC TRAINING\*

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In the correction of strabismus, orthoptic training plays a vital part in developing binocular vision. Orthoptics will give best results if the ophthalmologist, technician, patient, and parents work together as a team. It is necessary that the parents fully understand the important role that they play in correcting squint and the co-incident maladjustments. They should co-operate willingly throughout the training period.

The general term "binocular vision" means little more to the average person than a phrase relating to eyes. To obtain the coöperation of parents, it is necessary that they understand the significance of this term in its practical application to their child. This the ophthalmologist and technician must convey, for they know and realize the importance of binocular vision. It may mean, and frequently does, that a side course in orthoptics be given the parents before the case is completed.

Parents are anxious to correct strabismus in their children, but further education is needed before they can appreciate the importance of binocular vision and the training necessary for its accomplishment. Very little information on this subject has been given to the laity, and their lack of education is easily understood. The American Association of Orthoptic Technicians is preparing a pamphlet, as one of its projects, on "Information for parents," which ophthalmologists will have available. Modern conception has led most parents away from the old belief that squints can be outgrown. The parents should be told of the importance of an

early correction for squint, and the advantages gained by orthoptic procedures. This would help them to see the ultimate results, and would repay them for the time, effort, and expense involved.

It is the parents' right to know that binocular vision is not possible in every case of strabismus. All cases of strabismus are not suitable for orthoptic training. In doubtful cases, a trial period is given, and if definite progress is not noted orthoptic training is discontinued. These cases must depend on operative measures for correction. If glasses are prescribed by the ophthalmologist, parents should see that the child wears them.

It should be explained that surgery cannot improve the vision in an amblyopic eye, and, consequently, the necessity for occlusion. Occlusion of the fixating eye is imperative in order to develop vision in the amblyopic eye. Occlusion must be complete and constant to achieve the earliest and best results.

An effective occluder of adhesive tape with gauze pad can easily be made at home, the size varying to prevent irritation of the skin. Parents should be instructed in the care of using the adhesive occluder. A little cold cream or vaseline on the brow and lashes prevents them from sticking to the adhesive. The lashes of the upper lid should be massaged upward, when the grease is applied, to keep them from turning under and irritating the eyeball. When removing the patch, cold cream applied around the edges will make it easy to remove. Before a clean patch is put on, the eye and face should be bathed with warm water. Many other types of complete occlusion have been tried, but we have found the adhesive

\* Read at the second annual meeting of the American Association of Orthoptic Technicians, in Chicago, October 12, 1942.

patch to be the most practical and successful.

Until the vision in the amblyopic eye has improved sufficiently for normal daily use, the parents should help the child make readjustments. During the occlusion period, specially planned exercises are given. Young children have their favorite Mother Goose books, and enjoy them most when the illustrations are large and colorful. They will choose their story by the pictures that are attractive to them. With such simple procedures, the parents can begin their child's amblyopic exercise, gradually adding more detailed work as the vision improves. Materials should always be selected to induce a child to use the amblyopic eye.

The fears of the parents concerning the good eye can be relieved by explaining beforehand that the occluded eye, under observation, will remain unharmed.

The length of time necessary for complete occlusion usually depends on the age of the child, the time the eye has squinted, and the age when occlusion was begun.

The majority of our complete-occlusion patients are of preschool age and make adjustments sooner than do older children. School-age children often need partial occlusion, and should have the understanding and help of their teacher as well as of their parents. Their attitude about occlusion has much to do with the effect on the child. Often it is the parents who are disturbed by the sight of the occluder, rather than the child, and they advance excuses for removing it. The child is quick to sense the parents' attitude and then becomes unhappy about wearing the occluder. Children are not helped by pity nor undue praise. Unless study or play is above the visual or mental ability of the child, he should have the opportunity to participate in ordinary associations and activities. With proper encour-

agement and stimulation, parents can make occlusion lose its unattractive features. Parents should also help instruct the child's playmates so that they will adopt the proper attitude, and not tease and torment him because he is different. A father, with a sense of humor, printed across the patch his child wore, "Closed for Repairs." His humor was quickly adopted by the child, who joked with people about his "road sign." Little girls often patch their doll's eye and play "exercises" with them. One boy who wore occlusion played "pirates," conferring special honors on his playmate pirates by patching an eye after some brave deed had been performed.

Only in exceptional cases has it been advisable to discontinue occlusion. These children were either physically or mentally unfit, the amblyopia did not improve, or there was a lack of coöperation in the home.

After the first obstacles have been overcome, the average child accepts the occlusion as readily as glasses or dental braces.

Orthoptic treatment of squint would be greatly simplified if exercises at home could be omitted. However, planned daily exercises are recommended for successful orthoptic training. In most cases, this means that exercises must be given at home. It is seldom possible for a child to make daily visits to the orthoptic office or clinic throughout the training period. Time, expense, duties in the home, and outside obligations prevent daily attendance. The importance of this regular routine should be emphasized. Once the exercise habit is formed, it is accepted in the daily schedule on the same plane with school, music, and dancing lessons. Home environment and parental training largely govern the attitude and response of a child. Exercise periods at home can be

used further to establish intimate associations between parent and child. The child unconsciously develops good traits of character, such as perseverance and concentration in performing these daily exercises. Many wise parents take advantage of this opportunity to develop the mental growth of their child. Physical welfare is also essential, and time for outdoor play is desirable and stimulating. Proper attention to balanced diets, rest, and general health promotes advancement. With careful thought, the parents can make schedules to meet the needs of the individual child. In accepting parental responsibility, these conditions should be foremost in the parents' minds. This would constitute ideal care, but it is not possible for every child.

Some parents are anxious to begin home exercises immediately; however, sufficient development must be achieved before home training is possible. The condition of the eyes determines when home exercises may be given. Patients without fusion, those with abnormal retinal correspondence and large deviations must have office or clinic training first. During exercises at the office, better coöperation is obtained if the parents are not present. Their presence is sometimes distracting. They are apt to admonish the child and authority becomes divided between technician and parent. Exceptions are made during visual-acuity tests. The parents are asked to remain, as they are eager to have evidence of improvement and are very much impressed when they see the child read farther down on the chart on successive visits. Throughout this period, the parents' coöperation should consist of caring for the child's general health, keeping regular office attendance, and encouraging the child mentally. One mother, after seeing the "ball and box" picture slides used in the orthoptoscope, played

"ball and box" with her child at home. They tried to see how many times the ball could be thrown in the box from a given line. Later, they had a tea party and talked about what fun the "ball-box" game was, and it would be fine to put the ball in the box with her eyes on her next visit to the orthoptic office. With this type of mental effort, simultaneous macular perception was developed. This does not imply that all children playing "ball and box" will immediately develop simultaneous macular perception. It is an illustration of the encouragement and stimulation the parents can give, which helps promote the mental effort necessary to form the binocular habit.

After fusion has been established, preferably with some amplitude, and the deviation is small enough to permit practical exercises at home, orthoptic home training should be started. As a rule, this is the mother's duty. If it is impossible for the mother to attend to this duty personally, another person should be taught how to give the exercises. Merely to go through the motion of putting picture cards in and out of the stereoscope and getting "yes" answers, is not only a waste of time but develops bad habits. Unless exercises are given correctly, the child would much better be playing outside.

Progress is noted in accordance with the effort and time expended. The amount of time to be spent daily with exercises must, of course, depend on the age of the child. Younger children can be taught to work a half hour daily; older children may gradually increase their exercise time to an hour. This hour may be divided, half in the morning, and half in the afternoon. Exercises should not be left until night, as both parents and children are usually too fatigued for successful work.

Mothers can teach preschool children their colors, and to count with under-

standing up to five. Learning to recognize certain pictures is a great help when they have to come to the office for training. Sometimes the symbol E chart is given the mothers to teach the young child the "E" game, recording the different tests. These tests are not always accurate, but the child has usually learned what is expected of him, and, when he returns to the office, he is eager to "show off." In this way, a satisfactory record can usually be obtained in the office, and a great deal of time saved.

Some parents become enthusiastic about orthoptics and make equipment to use at home. Mothers may be taught to make cards for the stereoscope, corresponding to the child's deviation. Fathers construct bar readers, sometimes with head and hand rests, and set up stands for the recession exercise. The majority of parents depend on commercial equipment. Unfortunately, the choice of this equipment is limited and rather expensive. To combat this limitation, cards must be selected with care. This necessitates frequent repetition of the cards, and interest wanes. To offset this lack of enthusiasm, the children must be taught that eye exercises are given as a study period for the development of their eyes, and not as entertainment. The children receive the necessary stimulus for this by rewards. They often take great delight in a simple tea party which consists of cookies, fruit, or a piece of candy. The tea party, if presented play-fashion, makes a happy connection with the exercises. The discrimination between work and play may be taught early. The development of concentration can begin with eye exercises, without pushing the child beyond his mental capacity. A number of our mothers have reported improvement in their child's power to concentrate, since beginning orthoptic training. Parents should not expect this mental development too soon,

for it requires time and patience. Advice of a pediatrician should be sought regarding the physical condition of the child. Orthoptic training may be planned, concurring with this advice.

Often surgery is necessary in orthoptic cases, and explanations are helpful to parents in avoiding the confusion associated with surgery, glasses, and orthoptic training. It should be understood that eyes may not be straight after surgery, and other operations may be necessary. Some parents are disappointed because the glasses cannot be discarded after operation. It is important that they understand that surgery may give a quick cosmetic result and, in exceptional cases, possible spontaneous fusion without training. But orthoptic training, which is the longer, harder way, develops the muscle coordinations necessary for comfortable binocular vision.

#### SUMMARY

The parents should understand fully the following points:

1. Sufficient knowledge of binocular vision is essential.
2. The time necessary for the development of binocular vision varies with the individual.
3. In selected cases of amblyopia, occlusion is always necessary.
4. The child's response to occlusion largely depends on the attitude of the parents.
5. Home exercises must be thoroughly understood before they are practiced.
6. Stimulation is necessary for the required mental effort.
7. Surgery cannot accomplish alone what it does in conjunction with orthoptic training.
8. Full coöperation with ophthalmologist and technician is necessary to a successful training period.

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DISCUSSION

DR. MURRAY F. McCASLIN (Pittsburgh): Miss Walraven is to be complimented for her comprehensive presentation of "The parents' role in orthoptic training." The parents' understanding of an outlined plan and their coöperation through its successive stages are not only desirable but essential to the obtaining of a pair of functionally perfect eyes.

I believe that parents comprehend the situation if we reduce our terms to the simple language of the layman, and do not minimize the time required to obtain results.

One distressing feature the technicians

have to combat constantly can be laid at the doorstep of the physician. If I stress no other point, I want to impress on the physician these directions: Give the technician sufficient time. Do not speak in terms of weeks to your patient, but in terms of months, many months. By keeping the patient reminded of this single factor, fewer discouraged parents will have to be handled.

The explanatory booklet Miss Walraven is editing will be a great aid—something the parents can take home, read, and ponder. It fills a vital need at this time.

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AMAUROSIS FOLLOWING NASAL HEMORRHAGE

REPORT OF A CASE

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Sudden loss of vision following severe hemorrhage is a phenomenon which has been occasionally observed since the days of antiquity. While there have been many reports in the literature regarding this condition, it is exceedingly rare in proportion to cases in which loss of blood has been severe. A distinction may be made at the outset in regard to cases of immediate loss of vision from sudden ischemia, and those in which visual loss occurs after from several days to several weeks, the latter being probably the result of an anaphylactic or toxic reaction in addition to an inadequate retinal blood supply.

Visual loss in most recorded cases occurs typically after such conditions as hemoptysis and hematemesis, or from uterine or nasal hemorrhage. According to Zentmayer<sup>1</sup> in 70 percent of reported cases the hemorrhage was uterine or from the gastro-intestinal tract. Uncommonly it

may result from excessive blood loss from wounds or from surgical procedures. However, Robertson<sup>2</sup> states that there have been no reports of this type of visual loss due directly to hemorrhage from war injuries. Recurrent hemorrhages are more disposing to this condition than a single massive hemorrhage, regardless of the amount of blood which may be lost. Visual loss may be permanent or transitory, usually bilateral, but unilateral in about 15 percent of the cases (Duke-Elder<sup>3</sup>). The time of onset of blindness following hemorrhage is interesting since there may be quite an extended interval between the two. According to Terson<sup>4</sup> loss of vision occurs during the hemorrhage in 8.3 percent, immediately thereafter in 11.6 percent, within 12 hours in 13.2 percent, within 2 days in 19.2 percent, between the third and sixteenth days in 39.2 percent, and later than 16 days in 8.5 percent of cases. This condition may occur at any

age, usually, however, the patient is between 20 and 50 years old, and more frequently in females than males (Zentmayer<sup>1</sup>).

*Historical.* The first description of this condition in modern times was made by Gräfe.<sup>5</sup> In 1861, this author correctly attributed loss of vision to ischemia of the retina. von Graefe<sup>6</sup> described a case in 1866 in the terminal stages of cholera. A review of the literature by Terson in 1922 produced 250 cases of visual loss from this cause. Robertson, in 1941, reported a case following massive hematemesis with permanent and complete loss of sight. Langdon<sup>7</sup> described a case in 1933 following recurrent uterine hemorrhage over a period of two years. Substantial improvement followed repeated blood transfusions and eventually the condition was completely relieved by a hysterectomy, with return of vision to practically normal in each eye. Bistis<sup>8</sup> in 1908 originally reported a case of visual loss following nasal hemorrhage. A similar case was reported by Harbridge<sup>9</sup> in this country in 1924.

*Clinical findings.* As this condition is generally bilateral, it is, as a rule, reported promptly by the patient. Examination usually reveals dilated fixed pupils, unresponsive to stimulation, while the appearance of the fundus may vary from one practically normal to one of optic neuritis or neuroretinitis. In the milder cases there may be merely attenuation of the retinal blood vessels together with pallor of the disc. In more severe cases retinal hemorrhages may occur, usually superficial and occasionally preretinal. There may be peripapillary edema, although massive papilledema is not found. Many of the severer cases exhibit patches of edema along the retinal blood vessels, chiefly around areas of bifurcation, which may closely simulate retinitis of nephritic origin. In certain instances the appearance

of the fundus resembles that seen in quinine toxic amblyopia, and optic atrophy is frequently the end result.

The primary etiologic consideration is inadequate blood flow to the retina, the reduced arterial pressure external to the eye being insufficient to overcome the normal intraocular pressure. This, however, fails to explain the rarity of the condition and the frequent delay in its appearance after the hemorrhage. Other factors are apparently involved, and Terson suggested that extensive hemolysis or anaphylactic shock might be contributing causes.

*Pathology.* Pathologic processes of this condition are obscured by the fact that there have been few opportunities for detailed microscopic examination of these eyes. Goerlitz<sup>10</sup> microscopically examined several eyes obtained a few days after loss of vision from hemorrhage. His findings suggested that visual loss was the result of retinal ischemia followed by a diffuse retinal edema and eventually degeneration of the third neuron. These findings were confirmed by Uhthoff<sup>11</sup> in 1922, from experiments on dogs. According to this author, in the later stages there is thickening of the walls of the retinal blood vessels with thrombosis and organization with obliteration of their lumens. Experimentally, the end stage was invariably one of complete optic atrophy and widespread endarteritis.

*Prognosis* is generally unfavorable as regards restoration of normal vision. Tidy<sup>12</sup> stated that blindness is permanent in 33 percent of cases, in which instances the findings are those of optic atrophy. Since any degree of initial visual loss may be found, final vision may vary accordingly. In many of the reported cases, however, surprising visual improvement has taken place. Thus in Langdon's case (from recurrent uterine hemorrhage), restoration of vision was complete after

four months except for a disturbance of light sense. However, in not more than 10 percent of cases is vision restored to normal (Duke-Elder). There appears to be no correlation between the time of visual loss after hemorrhage and the eventual visual result.

*Treatment* consists primarily of prompt relief from further hemorrhage, since it is recurrent hemorrhages that have proved most damaging. The blood volume should be built up rapidly and Frey<sup>13</sup> found repeated blood transfusions useful in combating degeneration of retinal tissues and improving the ultimate prognosis. Should there be early loss of vision after the hemorrhage, attempts should be made to lower the intraocular pressure by the use of miotics and preferably eserine. Although local therapy has been generally ineffective in this acute threat to vision it is worth a trial. Lauber<sup>14</sup> advised paracentesis with repeated opening of the wound to obtain prolonged hypotony of the globe and thus stimulate retinal circulation.

#### CASE REPORT

R. S., a white woman, aged 52 years, was hospitalized on January 6, 1943, following severe spontaneous intermittent epistaxis of 48-hours' duration. The history was negative in regard to previous nasal hemorrhage, nor was there indication of blood dyscrasia or hypertension. Hemorrhage was exceedingly profuse, originating from the right sphenopalatine artery. It was controlled initially by means of a tight cotton postnasal tampon upon which was placed anteriorly a small iodoform gauze pack. The left nostril was entirely free.

*Laboratory findings.* Hemoglobin was 60 percent; erythrocytes 2,600,000; leucocytes 7,200. Differential count showed 70 percent polymorphonuclear cells, lymphocytes 29 percent, and eosinophiles 1 per-

cent. Bleeding time was 3 minutes, 20 seconds; clotting time 5 minutes. Kahn test was negative; the blood pressure, 136/95.

In spite of rather constant pressure there continued to be a slight oozing around the pack, so that it was found necessary to change the postnasal tampons on several occasions. Hemorrhage promptly subsided and on the following day the nasal tampons were removed. On the third day after admission temperature was elevated to 101.6°F., and the patient complained of a dull pain in the right supraorbital region. There was no evidence of acute sinusitis and ocular examination was negative. The ears likewise revealed no abnormality.

During the ensuing three days the temperature dropped to normal, but on the morning of the sixth day the patient suddenly noticed a blurring of vision in the right eye. Vision deteriorated rapidly and four hours later was reduced to the ability to count fingers at 10 feet. Marked photophobia was present together with the continuance of the dull supraorbital pain. Examination revealed a dilated immobile pupil of the right eye, unresponsive to light. On ophthalmoscopic examination a chalky-white pallor of the disc and peripapillary area of this eye was observed. There was such severe constriction of the blood vessels that they could be followed for only a short distance from the disc, peripheral portions of the retina appearing entirely avascular. There was a small area of edema along the middle portion of the superior temporal retinal artery. There were no hemorrhages, and the vitreous was entirely clear. Intraocular pressure was measured as 21 mm. Hg (Schiötz). No abnormalities could be demonstrated in the left eye, and vision was 20/20 with correction. Treatment was immediately instituted, using 0.5-percent eserine-sulfate solution combined with 0.5-percent dionine every two hours.

Plasma transfusions were given, as blood transfusion was not available, and subsequently repeated infusions were given. After six hours intraocular pressure was 18 mm. Hg (Schiötz). The results of immediate treatment were discouraging, and upon discharge from the hospital vision remained at finger counting at 15 feet. There has, however, been considerable subsequent improvement in vision, which has stabilized at 20/40. Ophthalmoscopic examination at this time presents no abnormalities other than a slight pallor of the temporal portion of the disc. No improvement in vision beyond 20/40 can be

obtained by refraction.

#### SUMMARY

A case of marked unilateral visual loss, occurring six days after profuse recurrent nasal hemorrhage, has been reported. Treatment consisted of local use of miotics and repeated transfusions, with negligible immediate results, but with restoration of vision in the affected eye to 20/40 during a three-month period. The nature and pathogenesis of this condition have been discussed.

*169 Main Avenue.*

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# GROENOUW'S CORNEAL DYSTROPHY

WITH CASE REPORT AND GENEALOGIC CHART

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Diseases which "run in families" have always exerted a fascination for clinicians and pathologists alike. Modern science has demonstrated that certain maladies, long considered hereditary, are actually contagious and are contracted by family contacts. Tuberculosis is a familiar example of this type of transference. Yet, on the other hand, investigation has proved that a multitude of human ailments long regarded as clinical entities are actually but manifestations of inherited idiosyncrasy. A protein sensitization may be as truly "hereditary" as polydactylism or red hair.

Students of genetics have found a most fertile source of information in the inheritance of disease tendencies, and no part of the body affords a better ground for exploration than does the eye. The eminent French ophthalmologist, Van Duyse, in his monograph on "Heredity in ophthalmology" (*L'Hérédité en Ophthalmologie*), published in 1931, made a masterly summary of the contributions to Mendelian characteristics and their transmission by inheritance that have been made by ophthalmologists since the theory was first propounded by the Austrian monk in 1865.

Among the numerous ocular anomalies and disease tendencies that Van Duyse discusses, he has but little to say of the particular familial condition with which this paper deals. He does not even mention the name of Groenouw, which has become inseparably associated with one certain type of corneal dystrophy.

Translated into English Van Duyse's discussion reads:

## FAMILIAL DEGENERATION OF THE CORNEA

A certain number of corneal affections have been classified by Fleischer under the head of "Familial degeneration of the cornea."

The chief member of this group, *nodular keratitis*, described by Fuchs, is characterized by the appearance of small opacities of a roundish but irregular contour, arranged in grill-formation arising from the parenchyma of the cornea. . . . Those of smallest size appear at the periphery where they are disposed in an irregular circle. Because of the uneven surface of the epithelium which the presence of these opacities causes, visual acuity is unfavorably influenced, a light veil of uniform density covering the surface between them.

The lesion has been noted most often in males; it appears usually in youth, persisting throughout the remainder of life. From time to time there are light attacks of acute inflammation, during which the affected-areas will increase slightly in size.

In the lattice type of keratitis (*la kératite en grillage*) the opacities arise in the thickness of the cornea; fine striations run between them, though the epithelium remains intact (Dimmer, Haab).

Fleischer considered nodular keratitis and the lattice type, which have many features in common, as being hereditary. Between these two main types, a goodly number of variations—often but single cases—have been recorded. In Fehr's case the opacities were very numerous, being formed by the confluence of numerous minute white points. These opacities occupied the center of the cornea, contrary to the observations in other cases, wherein the opacities had tended to extend toward the periphery.

Franceschetti admitted that familial degeneration of the cornea appeared to be transmitted after the dominant type. It is frequently observed in successive generations, and as has already been established for other hereditary affections, it is usually the same *type* of degeneration which affects the different members of the same family. Another fact worthy of remark: Degeneration of the cornea attacks the individual members of a family at the same period of life, so that it may be considered a *homochronous* type of hereditary disability. Numerous observations have shown that *nodular keratitis* is frequently transmitted to

the second, third, and occasionally even to the fourth, generation (Bachstez, Treacher Collins, Gutzeit).

A family tree was published by Tritscheller which included four families, in each of which certain members were affected with corneal dystrophy. While all four families had a common ancestry it was only in the fourth generation from this common root that the disability appeared. Franceschetti has commented on these observations that they illustrate in a remarkable, though inexplicable, manner how many other familial disabilities are transmitted (such as Friedreich's ataxia, myotonic dystrophy).

Only suppositions as to the etiology of this particular manifestation, are possible. Its appearance almost simultaneously in all four families would tend to prove it to be a low-value genotype, comparable to abiotrophies. That is, the affection originally made its appearance during the life of a certain member of a family. A certain number of generations of this family passed without the affection's being manifested. But at last it suddenly attacked members of several different branches of the genealogical tree, at a predetermined age, and in accordance with its pathologic characteristics, was transmitted after the manner of dominants.

Undoubtedly, other maladies due to dominant inherited characteristics, which appear suddenly in certain families, owe their origin to a like cause. Lattice-type keratitis has also been observed in two, three, and—rarely—four generations successively.

The correlation of the eye condition with other anomalies (psychopathic personality, defective intelligence, harelip, and the like) has been noted by Clausen.

Some seven years after Van Duyse wrote, Max Bücklers of the University of Tübingen's ophthalmologic service published an exhaustive monograph on "Hereditary dystrophy of the cornea" (Die erblichen Hornhautdystrophien), based on a study of more than 800 individuals, residents of a series of small communities geographically adjacent, wherein intermarriage had occurred so frequently that wide familial connections were very common, nearly everyone being more or less remotely related to everyone else. In this happy hunting ground for the student of genetics, Bücklers discovered a sufficient number of examples of hereditary lesions of the cornea to enable him to reclassify all the

previously reported cases, and to establish the existence of *no less than three* types, which he designated by the names of those investigators who had first drawn attention to them.

The type most often seen he found to be described by Fleischer in 1905—a circumscribed parenchymal disc dystrophy. The "lattice" type he assigned to Haab and Dimmer, who made public their observations in 1899, while the nodular dystrophy to which Groenouw directed attention in the last decade of the nineteenth century was distinguished by his name. Each of these morphologic groups he characterized by precise pathologic descriptions.

A somewhat different classification had been made in 1933 by the French ophthalmologist, Jacques Rollet, who commenced his monograph on "certain lesions of the cornea, which determine alterations in the transparency of this membrane, and often present hereditary or familial characteristics," by stating that "this chapter in the history of eye affections has never received the attention which it deserves." He goes on to say that following the invention of the slitlamp, he had high hopes that lesions of the cornea would come to be better understood and more promptly recognized. The possibility of examining corneal lesions *in situ* marked a long stride in advance in this particular branch of ocular pathology. While he had made a thorough search of the literature in an endeavor to collect and assign to their proper classification all the cases of hereditary and familial corneal dystrophy recorded during the pre-slitlamp period, he was basing most of his conclusions on five or six cases seen by him at the eye clinic at Lyon, the same that formed the basis for Cazeilles's 1931 *Thèse de Lyon*. Rollet defines the limits of his subject in these words:

Under the heading of keratitis, or of degen-

eration or dystrophy of the cornea, which is hereditary or familial, it has been customary to include epithelial ulcerations, modifications or alterations of the cornea's transparency . . . appearing in an eye otherwise normal. Such lesions have, as an essential common characteristic, their appearance in practically identical form in members of the same family circle, or can be demonstrated to have descended from one generation to another of the same family. All such lesions, however, have been shown to make their appearance at different life periods, or to have their site in different parts of the cornea, which would indicate that there are several different types of hereditary corneal opacities, presenting wholly separate clinical entities. This is what I seek to establish.

After stressing the importance of differentiating such hereditary and familial conditions from those with which they have so often been confused in the past, Rollet goes on to consider the historical aspects of his subject: He distinguishes three periods: (1) That in which a number of congenital corneal lesions were observed and described, but their true significance as hereditary or familial affections was not fully recognized. (2) The period beginning with "the interesting work of Groenouw, in 1890, who, in describing nodular keratitis, drew general attention to this curious chapter of corneal degenerations and dystrophies, and later, Haab, Biber, and Dimmer, who added to the confusion by describing the lesion as having a wholly different latticed appearance. But it was not until 1902 that Gunn, and, above all, in 1905, Fleischer, clearly showed the hereditary character of certain of these keratitides or dystrophies, a character which Groenouw was able to point out and add, in 1917, to his 1890 description by observation upon the descendants of the patient whose case had furnished the data for the original description. . . ."

(3) The period postulated by Rollet is "that in which—thanks to the biomicroscope—the actual appearance of the lesions can be better studied and classified." He named a long list of writers who have

contributed data—single cases and extensive studies of larger series—relating to the subject during the time period from the introduction of the slitlamp to 1932.

To this historical grouping he proceeds to add what he terms a "classification for clinical study," based on the *time of appearance* of the characteristic lesions. In the first group "the lesions existed and were observed at birth. These Rollet terms *heredito-familial congenital lesions of the cornea*. In the second group, the lesions began or made their appearance only late (relatively) in life, and then upon a cornea previously healthy in appearance. The initial appearance may come in infancy, however, but more often in adolescence (frequently at puberty), most rarely in adult life. The second group he termed *late heredito-familial lesions of the cornea*. These two groups he still further divides into the (a) *Superficial variety*, and (b) *Interstitial or deep variety*. He even subdivides these classes still further; however, in the present writer's opinion no useful purposes can be served by such minutiae of classification. But in order to make clear the difference between the types of corneal lesion described by Groenouw and those which are often confused with it but are, and should be kept, distinct both clinically and pathologically, it will be necessary to enter into a brief discussion of the other types of corneal lesion cited in the accumulated literature. This can be more easily accomplished by returning to the simpler division set up by Bücklers.

"*Fleischer type*" of Bücklers: This has been more recently termed *Dystrophia corneae adiposa or xanthomatosa* (Axenfeld, 1930). The striking feature of the clinical picture is the presence of small, ringed opacities in the central portion of the cornea. Some of these opacities lie in the superficial layers of the membrane,

although Von der Heydt asserts that they "show no preference as to depth" and that "the epithelium is rarely involved." This author saw a case in 1925 "which presented added superficial, definitely circinate lesions" and has likewise observed the same condition in three relatives—a mother and two daughters. Most of the cases reported in the literature began to be manifested early in life, but the progress of the opacities is regularly reported to be very slow, there seldom being any noticeable interference with vision before the thirtieth year, although the initial appearance may be as early as in the patient's fifth year.

"*Haab-Dimmer type.*" The "lattice" type of nodular dystrophy although noted in some of the earliest reports was first brought to the attention of ophthalmologists by Haab in 1899, under the designation *gittrige Keratitis*. In this type the opacities are so arranged as to form a network of fine lines lying in the pupillary area of the cornea's superficial layers. As the condition progresses, the surrounding epithelium gradually becomes opaque, as minute flakes or punctate areas intermingle with the "lattice," until vision is greatly diminished, or lost entirely.

#### GROENOUW'S TYPE

When Groenouw first described the form of familial nodular opacity of the cornea generally called by his name, he termed it "*knötchenförmige Hornhauttrübung*," that is, *nodular keratitis*. But it is interesting to note that one of his original cases was of the "lattice" type, which is at present associated with the name of Fleischer, and carefully differentiated from the "nodular" form, popularly assigned to Groenouw.

The salient characteristic of "Groenouw's disease" is the presence of minute opacities occupying the central portion of the cornea. These opaque areas may be of

almost any shape, usually grayish in color and appearing as nodules or flakes, varying in size from one or two millimeters in diameter to the finest dustlike particles. At the periphery of the cornea the membrane is seldom invaded, though a few authors have reported finding the dustlike particles at a considerable distance from the center. They are scattered between the larger nodules. The opaque patches thus formed lie in the superficial epithelium, which at the onset is unaltered but later recedes, leaving the patches elevated above the normal level of the superficial layer of the cornea. There is seldom any irritation, and ciliary injection or the formation of corneal blood vessels has not been recorded. As the condition progresses—which is very slowly—the opacities gradually become denser, while the anterior ciliary vessels enlarge by reason of distension. Thus vision is gradually diminished, so that, if the subject lives long, his sight will be reduced to light perception.

Groenouw's theory as to the clinical evolution of the condition is that the larger opaque areas are influenced by the size of the original corneal deposits; that the "grayish streaks" which he observed in one case were the product of line-formation by overlying opacities but histologically identical with the "nodules"; and that this was likewise the case with the very fine "dustlike" points. All the nodes he considered to be due to invasion of the epithelium by a "foreign" substance, which he assumed to be hyalin.

Eight years after his first publication Groenouw was able to present further data gleaned from microscopical examination of a small specimen excised from a cornea of one of the patients mentioned in his earlier description. He saw a "foreign substance" which was deposited in patches in the upper stratum of the substantia propria, often directly beneath the

epithelium, but never *within it*. Stained with hematoxylin-eosin this substance proved to be acidophilic, probably hyaloid in nature. Close to these foreign deposits the nuclei of the cells of the cornea seemed to have become more numerous, but no marked changes in the epithelium could be made out. Nor were there any signs of previous inflammation. Bowman's membrane, however, was entirely absent. In his third publication—made in 1917, after a lapse of 27 years—Groenouw could add but little to the original observations, and this is true, also, of those other investigators who have likewise studied this familial condition. Better instruments—notably the slitlamp and the corneal microscope—enabled them to make more minute examinations, but otherwise the original description remains unchanged after more than a half century.

#### ETIOLOGY

Neither Groenouw nor any who have come after him have been able to assign a cause for the formation of these corneal opacities. Fuchs, who expanded Groenouw's original investigations some 12 years after his first paper appeared, believed it to be the result of "a nutritional disturbance or dystrophy, the chief factor of which is failure of the tissue juices to dissolve (unknown) substances which are excreted." Fuchs also mentioned metabolic imbalance, which he called disturbance of internal secretion, as a possible cause of this excretion, but labeled the theory "unproved." Treacher Collins, at about the same time, classified the condition as an "abiotrophy," regarding it as a neurotrophic disorder. He believed it to be a primary dystrophy of the fibers and end-organs of the corneal nerves, a conclusion reached by the correspondence which he observed between the distribution of the nerves and the arrangement

of the corneal deposits. Several other investigators agreed with Treacher Collins, but Rudolf Stanka, writing in 1925, asserted he had disproved this etiologic theory through the use of "vital" staining. He advanced the contention that the corneal condition was due to a degenerative process of the corneal lamellas, or possibly to a hyaline degeneration in the domain of the corneal corpuscles themselves, which had been transformed into a "peculiar glassy substance," or had disappeared entirely leaving the glassy substance in their place.

The fact that the corneal condition was found in a number of instances to be coexistent with tuberculosis led Wehrli and certain other investigators to conclude that the tubercle bacillus was a factor in the production of the eye condition. Wehrli claimed to have demonstrated tissue changes to be very like, if not identical with, those found in tuberculosis of the skin (lupus), and, in one of his preparations for microscopic study, to have found a segmented acid-fast bacillus, which he regarded as a tubercle bacillus of low virulence. Recent work has not tended to confirm Wehrli's opinion, and there would seem to be no evidence offering any ground supporting a tuberculous etiology. In fact, we are quite as ignorant of the cause of the condition bearing Groenouw's name, at the present time, as Groenouw was when he first encountered it.

#### PATHOLOGY

Groenouw's original description of his pathologic findings is more general than those which more modern investigators have set forth for the particular condition to which his name is now attached. "Nodular dystrophy" has, however, been quite fully described by competent authority, and at least two ophthalmologists have had opportunity to make histologic studies

of an entire eyeball. Ladekarl excised some of the nodules and published the histologic findings.

When one of Paderstein's patients met death through an accident, he was able to obtain and section the entire eyeball. The epithelium of the cornea was found to be greatly thinned, and the normal relation between the round and the cylindrical cells considerably disturbed. In the area where the cells were lacking a homogeneous hyaline substance filled the empty spaces, coming close to Bowman's membrane, or verging directly upon it. Layers of hyaline substance "like onion flakes" made up the nodules in some places, whereas in other areas the hyaline appeared to be fibrous. The overlying nodules sometimes pressed upon Bowman's membrane to such an extent as to vary the thickness of this structure considerably throughout its extent. In some places it was impossible to differentiate the normal membrane from the hyaline substance, which also overlay the basal epithelial-cell layer. The cells of this layer showed some nuclei in normal condition, but more of them were degenerated and vacuolated. No changes could be made out in the parenchyma of the cornea.

These observations led Paderstein to the conclusion that the basal epithelial-cell layer was the original focus of the affection. Degeneration of these cells caused hyaline substance to form, the degenerated cells by agglomeration eventually making the characteristic nodules. He found between these cell-groups of completely transformed elements, a scattering of cells which were only partially destroyed. In this way he explained both the cells and the "cell remains" observable between the layers of hyaline deposit.

The "foreign substance" envisaged by several of the earlier investigators was considered by Pillat to be merely a secondary phenomenon depending upon a

previous degeneration of the corneal nerves. In his own case he demonstrated enlargement of the nerve terminals, and thickening of the nerve filaments themselves, with inequality of the thickening. The Chinese ophthalmologist, Chou, demonstrated this irregular thickening of the nerve filaments in one of his cases, but found no similar abnormality in any other cornea among his seven patients. In the majority of Chou's cases the central parts of the nerves were obscured by the opacities, whereas the nerves at the periphery were practically normal in appearance. Indeed, none of the corneal nerves in his series were impaired "to any significant degree, and therefore, a frank relationship between the opacities in the cornea and the pathological changes of the nerves is lacking." It is Chou's own opinion that the corneal opacities are the result of "some endocrine disturbance," which "for some reason or other, starting in puberty, interferes directly or indirectly with the normal metabolism of the cornea." Two of his patients were very fat, one having started to grow obese at the age of 16 years. Another patient exhibited thyroid disturbance, showing rapid pulse, palpitation, and enlargement of the gland, as well as menstrual irregularities. He concluded that "disturbance of the endocrine system at the age of puberty or earlier, may have a certain influence on the metabolism of the cornea, which has been predisposed to such a degeneration. Our present knowledge of the endocrine secretion does not inform us in what respect and how their disturbances are responsible for the local degeneration of the cornea, particularly when there is no similar degeneration in any other organs of the body."

This disturbance in nutrition, Chou thinks, accounts for the transformation of the corneal lamellae into a hyaline substance, or the deposition of a foreign

substance as either hyaline or amyloid in the superficial layers of the cornea may be the result of a disturbance of the cornea's nutrition. This would most likely be influenced by a change in the local metabolism, the most central portion being the most affected, because it is this area which normally gets the least nutriment. In support of this contention, Chou gives pathologic details of one of his cases.

In the right eye of this patient where we find many deep vessels, the opacities are represented by only three small dots. These deep corneal vessels abnormally better nourish the cornea, and therefore, alter metabolism, which in this particular patient has always been below the general level. The metabolism becomes accelerated again. It, therefore, tends to prevent the further development of the opacities. On the other hand, in the left eye of this same patient where there are no newly formed vessels in the cornea, the disease has become well advanced. We would probably have seen the disease in the same degree of severity if the deep vessels had not been present. . . . This instructive case would lead me to believe that for the development of the opacities in the cornea the disturbance in nutrition is chiefly responsible.

With one exception, recent literature concerning Groenouw's corneal dystrophy provides no records of histologic examination. This exception is Ladekarl's report, made from Copenhagen, in 1930. The patient was a woman, aged 30 years, from whom no familial history of impairment of vision could be elicited. The description of the condition of the cornea in either eye tallies closely with the classic picture outlined by Groenouw, and since repeated many times. "In the right eye, in the lower half of the cornea, four prominent opaque areas, resembling sago grains, were seen to stretch from four o'clock across the lower pupillary region toward seven o'clock. . . . In the left eye . . . the nodules are more numerous than on the right . . . by their partial conglomeration, a vaulting protuberance is formed on the surface." Most of these protuberances were removed and the excised pieces fixed for microscopic examination.

I. *The epithelium* was found to vary greatly in thickness, areas with normal numbers of cell-series alternating with areas in which there were only 2-3 strata of cells. Stretches with only one layer of quite flattened cells, devoid of distinct nuclei, even were noted. These thin epithelial areas had a situation corresponding to the pathological changes in the stroma, showing a highly irregular cellular arrangement. Basal cells could not be recognized, and there were no distinct cell-borders, the nuclei, moreover, being poor in chromatin, and both vesicular and vacuolized. Nuclei occurred frequently, and here and there, signs of karyolysis. Even in the places where the stroma appeared to be unaltered and the epithelial layer of normal thickness, vacuoles in the nuclei were frequently encountered, being an evidence of the beginning of a morbid process. The transition from multilayered to singlelayered epithelium, was sometimes quite abrupt, and in regions where the epithelium was most thin, it was frequently detached from the underlayer.

II. *Bowman's membrane* was found to be intact in those few places in which the epithelium and stroma appeared to be normal, but where the transitions to thinner epithelium were perceived, it was frayed and disappeared in the network texture of the stroma.

III. The changes of *the stroma* which seemed restricted to the more superficial layers, were of two kinds; i.e., in part, a splitting up of the lamellae, giving rise to a network texture with long meshes parallel to the surface, and in part, a transformation to a mass of a more homogeneous aspect, edematously swelled, as it were. Both changes may give rise to the nodular formation, as they were seen to cause the epithelium to protrude above the level of the surrounding parts. Since the epithelium in those parts is atrophic, the change of level in the surface is really less marked than what would correspond to the changes in the stroma. In the split-up areas there seemed to be a slight increase of corneal-cell nuclei, located for the most part, along the partition walls of the network, being frequently of larger size and lighter shade than is normal, though they were infiltrated with liquid. The protoplasm of the cells could not be recognized. In one place alone, a few migratory cells were isolated in the mesh spaces, which otherwise appeared vacuolized. No other signs of inflammation could be detected. The areas showing a more homogeneous appearance, as noted above, may, beside swelling into nodular formation, be found also in more extended stretches without displaying changes of level. The covering epithelium, however, was always atrophied, and Bowman's membrane missing. Stained by van Gieson's method, these homogeneous areas sometimes displayed a slightly lighter-red shade than the normal-appearing layers of the stroma, containing only



some few isolated, weakly staining, thick nuclei. It seems probable that these homogeneous, lighter areas were on their way to hyaline transformation, though no certainty in this respect could be gained from the various staining preparations.

#### FAMILIAL ASPECTS OF NODULAR DYSTROPHY

The familial occurrence of nodular dystrophy of the cornea was not noticed by the earliest investigators of the condition. Groenouw had nothing to say of it in either his first or second communications. But when Fuchs wrote in 1902, he noted that he had seen a precisely similar clinical picture in two brothers. In the Transactions of the Ophthalmological Society of the United Kingdom for this same year, and two years later (1904), we find papers, first by Gunn, reporting 4 cases in a family of 10, and, second, by Spicer, who found the nodular opacities in a father and daughter and obtained a history of an identical lesion in the eyes of the father's father's brother and sister, thus showing its occurrence in three consecutive generations. At this same period, on the Continent, Freund published a careful study of two families, named respectively Bienert and Herrman, living in small communities in Bohemia. He traced the family history through four generations, finding seven cases in the Bienert line and eight in the Herrman side. Most of the corneal lesions were of the "lattice" type rather than Goenouw's dystrophy, but the familial incidence was similar. In 1917 Groenouw published his third paper, and in this the descent of the corneal lesion from one generation to another was emphatically featured. He placed in evidence the genealogic table of the descendants of the patients first seen in the last years of the nineteenth century. The first patient had been twice married; among the offspring of the first marriage two daughters and a granddaughter were

affected; one daughter of the second marriage likewise showed the lesion. Since then many family trees have found their way into ophthalmic literature, one of the most interesting being that published by Judd, of Omaha, in 1933. Both the nodular and lattice forms are represented in his table.

Reports of one or more cases have been made by Doyne and Stephenson (1905), Green (1909), Zentmayer (1917), Evans (1930), Goar (1930), Srinivasan (1932), Ridley (1936), Somers (1936), Cowan (1937), and Lund (1941).

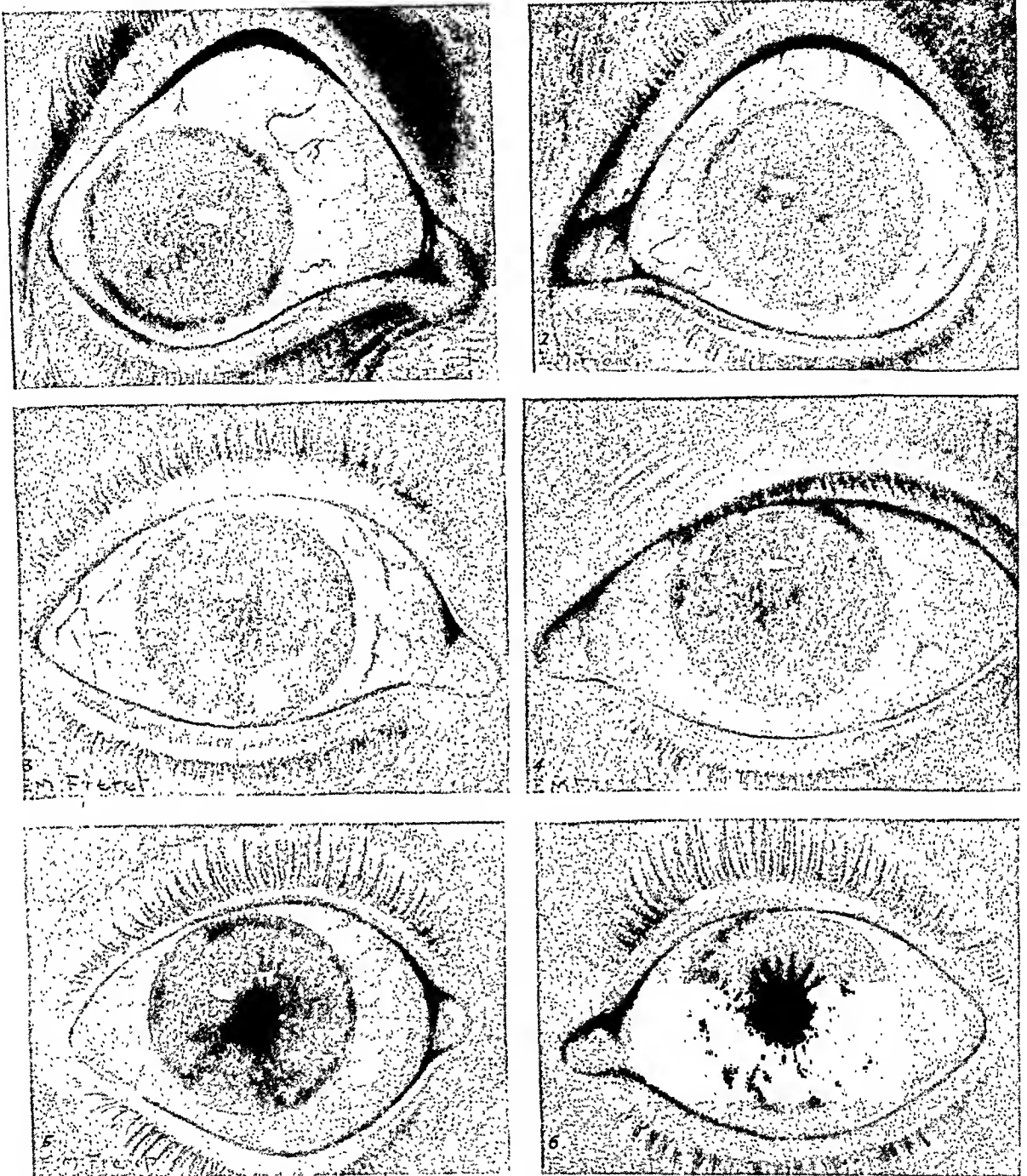
#### TREATMENT

The volume of literature just reviewed gives us little or nothing concerning the possibilities of treatment. Ladekarl's patient underwent removal of most of the nodules, in the hope of improving vision, but we are provided with no details of the final results. Most of the other papers conclude gloomily that the condition is progressive and incurable, and complete loss of vision may be the outcome, if the patient lives long enough. But in most cases, death from some unrelated cause overtook the patient before he became wholly sightless, so slow is the evolution of the condition.

In November, 1933, Hager published reports on two cases of Groenouw's dystrophy, and described a treatment which cleared "the intermediate areas" although it did not abolish the nodules themselves, nor even cause them to decrease in size. This treatment consisted of inducing an intense hyperemia by daily massage for five-minute periods with a mixture of dionin 0.3, blue ointment, and vaseline ad 10.0, with the addition of heat and administration of atropine. Both patients were otherwise in good health.

It is the opinion of the present writer, however, that any measures so far sug-





Figs. 1 to 6 (Wetzel). 1 and 2, Artist's sketch of right and left eyes of patient No. 1 in genealogic chart. 3 and 4, Artist's sketch of right and left eyes of patient No. 2 in genealogic chart. 5 and 6, Artist's sketch of right and left eyes of patient No. 8 in genealogic chart.

gested are valueless so far as permanent results are concerned.

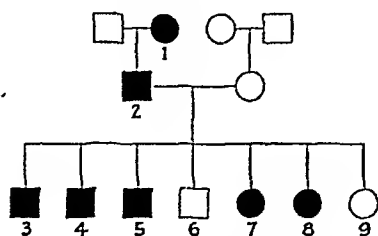
#### CASE REPORT

Mrs. M. W., an obese woman, 81 years of age, consulted me because of failing vision. The general physical examination

showed nothing noteworthy except marked edema of both legs, and a loud systolic murmur at the apex. Radiographs of chest and skull were negative so far as the ocular condition was concerned, and the laboratory afforded no help, for the findings in urinalysis and blood count, as

well as blood chemistry—for sugar, calcium, and nonprotein nitrogen—were within normal limits. The general health had always been good until she was well past the Scriptural limit of three-score-

CHART 1



GENEALOGIC CHART

Familial Incidence of Groenouw's Corneal Dystrophy

1. M.W., Grandmother, age 81 - Vision, O.U. Light perception
2. Martin W. " 59 - " O.D.  $\frac{1}{60}$ : O.S. Light perception
3. V.W. " 33 - " Corrected: O.D.  $\frac{1}{2}$ : O.S.  $\frac{1}{30}$   
(Successful corneal transplant)
4. Arthur W. " 31 - " Blind following corneal transplant (Secondary glaucoma)
5. Max W. " 21 - " Corrected: O.D.  $\frac{1}{30}$ : O.S. L.P.  
(Corneal transplant in O.D.)
6. Paul W. " 20 - " O.D.  $\frac{1}{15}$ : O.S.  $\frac{1}{12}$   
Corrected:  $\frac{1}{60}$  O.U.
7. Ann W. " 18 - " O.D.  $\frac{1}{30}$ : O.S.  $\frac{1}{60}$  (Blurred)
8. Pearl W. " 16 - " O.U.  $\frac{1}{60}$  (Blurred)
9. Bess W. " 15 - " O.U.  $\frac{1}{12}$ , corrected to  $\frac{1}{15}$  O.U.

○ - Female

□ - Male

● ■ - Groenouw's Corneal Dystrophy

and-ten, when swelling of the legs began to make walking difficult. Recently there had appeared a tendency to stumble at night, which might possibly be attributable to the eye condition.

**Ocular examination.** Vision in each eye was reduced to light perception. The right eye was quiet, the cornea showing the typical "ground-glass" appearance, more dense and irregular at the center, with a fairly clear area, 1 to 1.5 mm. wide, at the periphery. The condition of the iris of the right eye could not be determined, although the anterior chamber seemed to be of normal depth. When the loupe was used, many faceted nodes and irregularities, resembling calcium deposits, could be made out. The slitlamp showed a dense

infiltration of the cornea by a hyaline-like substance, this infiltration extending to the deeper layers of the cornea; the surface was irregular. On direct focal illumination it was evident that the deeper structures were involved. With the Schiötz tonometer the intraocular pressure measured 21 mm. Hg.

The findings in the left eye were essentially the same, with the exception that the anterior chamber appeared deeper than that in the right eye. In neither eye could the fundus details be made out.

**Past ocular history.** The patient related that when about 10 years of age, while in school, she had difficulty in seeing writing on the blackboard. Many times the eyes burned and were "sore," but she recalled no attacks of acute inflammation. At about the age of 15 she was struck over the right eye with a ball, but does not in any way connect her present difficulties of vision with this accident. After her sight became markedly impaired she spent many hours in a darkened room, but claims that she experienced no pain at this time.

**Personal and family history.** The patient emigrated from a small province outside Dodstädt, Germany, in company with two brothers, an uncle, and aunt. She was one of nine children. Of the two brothers who came with her to America, both now dead, one suffered from the same eye ailment, eventually becoming blind. As well as the patient can remember, of the members of her family remaining in Germany, the father, two other brothers and two sisters, had "trouble with their eyes," and her impression is that the condition was identical to that from which she has suffered. Her descendants are noted on the accompanying table. One son is now living, but two other children died shortly after birth. The son has had a family of seven children, sex and eye condition being noted

on the chart. The younger members of the family were kind enough to come in for examination on request, after the interesting history of grandmother and father had been disclosed. There remains a possibility that this family may derive from the same sources as those supplying Bückler's material, but the two maps accompanying his monograph do not show the patient's birthplace.

Careful inquiry into the physical and medical history of the three generations of this family has revealed nothing in common outside the visual defect except a basal-metabolism rate ranging from minus 5 to minus 32. This low rate suggests the possibility of an endocrine element in the familial recurrence of the eye condition. It will be recalled that the Chinese observer, Chou, inclined to a belief that endocrine imbalance might be responsible for the factors influencing the formation of nodules.

#### SUMMARY

Hereditary eye defects have furnished genetic data for many scientific investigations, thereby encouraging the study of such visual impairment. Familial nodular degeneration of the cornea is one of the most interesting of these conditions, though it has not received as much at-

tention as have others which occur more commonly.

Three types of this condition have been postulated: the circumscribed parenchymal disc dystrophy of Fleischer, the "latitude" type of Haab and Dimmer, and the nodular dystrophy of Groenouw.

The introduction of the biomicroscope and slitlamp enabled ophthalmologists to study these lesions *in situ*. The salient characteristic of Groenouw's disease is the presence of minute opacities in the center of the cornea, somewhat elevated above the level of the superficial layer of this structure. These opacities gradually become more dense, so that if the subject lives long enough he becomes entirely blind. The cause is not known.

The familial incidence of this affection was first noted at the beginning of the present century by Fuchs, and extensively studied by Freund, who followed it through four generations in two family lines.

No effective treatment has ever been discovered, although various, suggested measures have improved the condition of individual patients.

A case report is offered and a genealogic chart provided showing the incidence of the condition in three generations of the same family.

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## THE TREATMENT OF AMBLYOPIA\*

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The correction of amblyopia is the most spectacular and encouraging phase of orthoptic treatment. The parents are better able to appreciate the gains made if visual improvement occurs, whereas the value is not so obvious to them in the other phases of orthoptic training. Amblyopic training, when successful, has more economic worth than have the other phases of orthoptic exercises in that defective vision in one or both eyes is a bar to employment in industry whereas the presence or absence of the various grades of fusion or the presence of abnormal retinal correspondence is appreciated and required, at present, only in specialized pursuits, such as securing a license from the American Board of Orthoptic Technicians or in the fields of aviation.

Of all the various phases of orthoptic training, the correction of amblyopia is the least expensive to the patient. It requires little time at infrequent visits to check the vision and encourage the continuation of the training. When unequal vision in the two eyes as a result of amblyopia is encountered, the amblyopia must be corrected first before any thought of fusion training or overcoming suppression can be entertained. In spite of this axiom, fusion training is attempted by many specialists who do not first seek to correct the functional defect in vision. This lack of understanding on the part of the physician or technician results in failure and discouragement for everyone concerned. Others who watch the progress made by a group of patients similarly

treated are apt to consider orthoptics a fad or commercial venture.

Amblyopia can be briefly defined as diminished visual function without evident cause. It may be bilateral or monocular and it may or may not be accompanied by strabismus. The theories causing amblyopia cannot be taken up in this discussion except as they affect the treatment of amblyopia.

This discussion concerns the treatment of acquired amblyopia, a functional condition, as compared to congenital amblyopia of organic origin. It is readily recognized that the latter has not been scientifically investigated, due to the inherent difficulties presented by such a study. No adequate method has yet been devised to separate the acquired from the congenital amblyopia. We can only conclude that those conditions which show no visual improvement after all forms of amblyopic treatment have been tried for a prolonged period are probably of congenital origin, whereas those showing visual improvement are acquired. This statement clearly expresses the inadequacy of our present knowledge concerning this condition. Amblyopic subjects having eccentric fixation are considered by some to exhibit advanced manifestations of congenital amblyopia, and, although reports of visual improvement by occlusion are available, this has not been my experience.

Formerly I considered children who were able to make out small figures or letters with the amblyopic eye proper candidates for amblyopic training, and those who had poor reading vision congenitally defective. I have learned by following a considerable number of these children that this method of separating functional from organic amblyopia is unreliable.

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\*From the Department of Ophthalmic Surgery, University of Michigan. Read before the second annual meeting of the American Association of Orthoptic Technicians, in Chicago, October 12, 1942.

The periodic visual examination in schools is doing much to uncover defective vision in one or both eyes. This is accomplishing much in preventing amblyopia from developing where there is considerable difference in the refractive error of the two eyes, where a strabismus is present, or where the refractive error is high in each eye. In the latter group it is occasionally found that by simply correcting the high refractive error the vision in the two eyes is not brought up to normal but that it often continues to improve after the correcting lens has been worn for a time. Such visual improvement is not only seen in children but in adults who had previously worn no correcting lenses for their bilateral ametropia.

A more complex problem is presented by the group showing considerable difference in the refractive error of the two eyes. By the time the condition is discovered, correction of the ametropia seldom overcomes the amblyopia. This group should not only wear their cycloplegic correction but should receive some form of occlusion therapy. Atropine (1 percent) used once daily to occlude the vision of the better eye and force the individual to use the amblyopic eye constantly elicits fewer objections from parents than do any of the various methods. However, this form of occlusion entails some danger. The mother may not compress the lacrimal passages sufficiently to prevent too great an absorption of the atropine, resulting in atropine flush or poisoning. Secondly, there is danger from poisoning, for atropine that remains in the home for several months is quite likely to get into the hands of children. This method of occlusion is very satisfactory if the atropine decreases the vision of the better eye sufficiently to induce the child to fixate with the amblyopic eye. With this, as with any form of occlusion, the child should be reexamined every few weeks to make sure that treatment is being carried

out according to instructions and that no systemic symptoms are developing. This check also enables one to offer encouragement in the continuance of the treatment and to check the vision of the amblyopic and occluded eye with the correcting glasses. Too prolonged or uncontrolled occlusion may cause transfer of the amblyopia from one eye to the other, making it necessary to discontinue the occlusion or transfer it to the previously amblyopic eye, as pointed out by Worth.

If atropine is found ineffectual in transferring fixation to the amblyopic eye or cannot be used because of systemic symptoms, or for other reasons, the better eye may be occluded by a bandage, a pad, or by one of the various forms of shields for this purpose. The bandage or pad is generally the most satisfactory method. In very young children this occlusion is often difficult to maintain without applying elbow splints made from tongue blades and adhesive. Adhesive plaster applied to the face for long often causes irritation. Johnson and Johnson isinglass plaster has proved to be much more satisfactory. This can be removed with water.

The Doyne occluder or various forms of the suction-cup occluder are excellent for the use of older children or for those whose vision has improved to 6/12 or better. Practically all children, however, have a tendency to look about the margin of the occluder when they wish to see better. Hence, these occluders are usually unsatisfactory in treating the higher degrees of amblyopia.

Some physicians advise a few hours' occlusion of the fixating eye each day, but the most rapid and satisfactory method in my experience has been total and continuous occlusion. The child is usually very clumsy and may experience a great deal of trouble in assisting himself if he has a higher degree of amblyopia, but this difficulty seldom persists for more than a few days' time, and he is able

to get about and can often carry on with his school work fairly well. It has been repeatedly shown that close work accomplishes more visual improvement than do longer periods of other activity. For this reason drawing, stringing colored beads, and such exercises should be encouraged.

In most cases, there is demonstrable visual improvement after complete and continuous occlusion. In order to maintain this improvement it is necessary to overcome suppression, correct any squint that may be present, and to develop a good fusion amplitude.

Orthoptic clinics vary as to the degree of vision considered desirable before other forms of orthoptic treatment are initiated, but it is usually practical to begin treatment when 6/12 vision is attained. Even after orthoptic treatment has been begun, it is necessary to continue semi-occlusion by using cellophane paper or by other means, as outlined in the various texts on orthoptics.

The few instances in which the child is found to stammer after the eye has been occluded can usually be controlled by small doses of luminal or other sedative. Some parents, however, refuse further occlusion unless their fears are allayed.

There is another group of individuals who show amblyopia in one eye not apparently due to ametropia primarily but due to the presence of strabismus. These

patients may show such little difference in the ametropia of the two eyes that it could not be the cause of the amblyopia. Most of these patients, as pointed out by Abraham, presented or had presented unilateral strabismus as the causative factor in producing the suppression and subsequent amblyopia. These cases require the same type of occlusion therapy as those primarily due to ametropia. The same prognosis for successful treatment can be expected from each group. The deeper the amblyopia and the older the individual the poorer the chances are for improving the vision in the amblyopic eye: thus emphasizing the desirability of early recognition and treatment.

#### SUMMARY

The early recognition and treatment of amblyopia offers the greatest percentage of successful results. The entire field of orthoptic treatment is opened up for subsequent exploitation only through its successful correction. Those individuals obtaining and retaining acceptable industrial vision have a tremendous economic advantage. No amblyopic eye should be considered due to a congenital defect until all forms of occlusion therapy have been used continuously and totally for a period of several months without demonstrable visual improvement.

*201 South Main Street.*

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#### DISCUSSION

ANNE W. ADLER (Ann Arbor, Michigan): The main aspects of the treatment of amblyopia have been covered by Dr. Fralick. The experience gathered in our Clinic was in accordance with the presented views. It remains for me to discuss some practical points of this treatment as carried out in our Orthoptic Clinic.

Dr. Fralick emphasized the dangers entailed in the use of atropinization as a method of occlusion. We therefore use

atropine only very rarely. Our method of choice is total occlusion by patching with silk isinglass plaster. We apply total occlusion in all cases where the vision of the amblyopic eye is less than 6/24. It is needless to emphasize that the fixating eye must be completely covered day and night and the patient or the parents in the case of small children should be urged not to remove the occluder. Some clinics consider it desirable, when dealing with very



nervous children, to commence by occluding the eye for a short period each day, gradually increasing the length of time until the occluder is worn constantly. We ourselves had to do that in one case in which the child started to stutter when occlusion was applied.

If occlusion has been carried out conscientiously improvement of one Snellen test line per month on the average has been observed. Patients are visiting our Clinic once or twice a month—twice in the case of small children—for recheck of both the amblyopic and the sound eye. In no case did we observe deterioration of the vision of the sound eye, although we lost some cases because of fear of such deterioration on the part of the parents. If the vision in the amblyopic eye has improved to 6/9, partial occlusion with the use of opaque paper or colorless nail polish, can be applied. Occlusion has not been discontinued, even though the vision of both eyes may have been equal, until the amblyopic eye continued to fixate after the fixating eye has been uncovered. Orthoptic treatment was commenced at this stage.

Since the majority of patients in the treatment of amblyopia consists of children, it is important to instruct the parents properly in all details of the procedures to be followed by them. It is this point which is often of decisive value in the treatment of amblyopia in children. The attention of the parents is especially drawn to the possibility of "peeking" through the patch. The coöperation of the school teacher is of no less value. It is frequently necessary for the parents to contact the teacher and ask for his assistance and consideration in helping the child to overcome the difficulties that arise from the impaired vision during occlusion. The value of home exercises in combination with occlusion in the treatment of amblyopia is well known. It might be advantageous to ask the children

to bring their accomplished work, their tracings, drawings, paintings, and the like, to the Clinic and even to arrange small exhibits, as we have done in our Clinic, for further stimulation and encouragement.

Some authors assume that occlusion is of questionable value in children over seven years of age. Our attitude, however, has been to apply occlusion without regard to age; with the idea in mind that prolonged and carefully applied occlusion will help to improve the vision in some of the children over seven years of age. In older children psychology and educational influence might greatly help in achieving the goal. A closer coöperation may be secured by discussing with the children their future plans. They readily yield to the explanation that good vision in both eyes may be the basic requirement for occupations such as flying, engineering, driving, nursing, and so forth.

Undoubtedly, as Dr. Fralick has pointed out, the earlier amblyopia is treated the more promising and satisfactory are the results. Generally, children under seven years of age require approximately two weeks to improve their vision by one Snellen test line, while children over seven years required, according to our experience, approximately four to six weeks for the same improvement. It should be added that in the beginning some older children showed improvement, but, after some time, no further progress could be achieved and their distance vision remained stationary. Their near vision, however, as tested by Jaeger tables improved to J1.

In conclusion, our experience has taught us that no generalizations can be made in the treatment of amblyopia by occlusion, and that each case has to be treated individually and be given the benefit of occlusion therapy for a prolonged period of time.



# GRAPHIC REPRESENTATION OF BINOCULAR FINDINGS

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Galesburg, Illinois

A binocular examination often requires attention to numerous details and unless such information is recorded in comprehensive and systematic fashion, it may prove meaningless as a basis for interpretation or for comparison with follow-up studies. The recording of a heterophoria or a prism vergence alone is insufficient. One must specify whether such findings represent a 20-foot or 13-inch test response in order to evaluate whether the so-called eyestrain is aggravated by using the eyes for far or for near.

To be critical of one's findings we should note carefully:

1. The method of testing—whether by prism, Maddox rod, stereoscope, or other selected means.
2. Type and size of test target.
3. Whether tests were carried out under cycloplegia; or (and) with corrective lenses (noting prescription).
4. Deviation (phoria or tropia) reading for far and for near, and note method used.
5. Prism vergence (or duction) and note whether prism or stereoscope method is used. Indicate:
  - a. Prism divergence or abduction, with base-in prism.
  - b. Prism convergence or adduction, with base-out prism.
  - c. Prism sursumvergence (or supra-vergence or -duction), with base-down prism.
  - d. Prism deorsumvergence (or infravergence or -duction), with base-up prism.

The maximum amount of prism that either or both eyes can maintain until a "break" or diplopia occurs is noted as the

*breaking point*; when fusion is gradually restored after reducing prism strength, it is noted as *recovery point*.

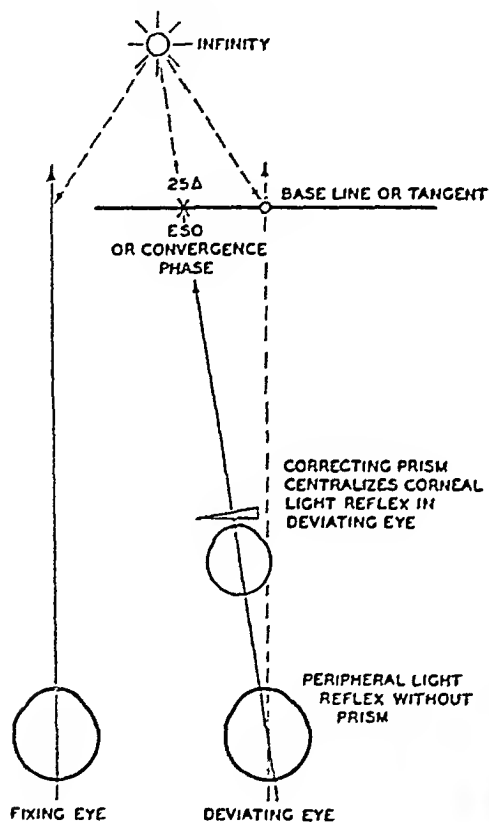
To simplify the recording of such a detailed report, I have designed a simple line arrangement (fig. 1) which, for want of a better term, I shall call a graph. This line runs horizontally and is based on the displacement of the visual axis from the "O" or primary position tangentially outward or inward when either eye deviates (tropia or phoria), or is made to deviate artificially by prism or target displacement as in a stereoscope. The "O" or primary position demarcates the divergence from the convergence phases, respectively, and for the sake of uniformity readings to the right of this position have been selected to indicate divergence or Exo, and to the left convergence or Eso. The excursion or pull which the eye can effect in response to a prism is represented by an arrow line (fig. 2) running away from this "O" position as prism strength is increased, or toward the primary position as prism strength is reduced. The latent position which the eye assumes as in phoria or tropia is denoted simply by a cross on the base line to show whether the deviation is in the Exo phase to the right or in the Eso phase to the left of the primary position. If the visual axis of the nonfixating or covered eye continues in the direction of the "O" or primary position, orthophoria is said to exist.

If a base-in prism be placed before either the right or the left eye to test the extent of divergence or binocular stress, the pull is indicated by means of an arrow line leading away from the "O" or primary position and the number of prism diopters required to break fusion is noted by plac-

ing the number of prism diopters at the head end of the arrow. In the case of base-in prism, the arrow line would run in the divergence phase or to the right of the "O" position irrespective of whether prism be placed before right eye or before left eye. The direction of the arrow likewise indicates the direction or pull of the eye toward the breaking point. An arrow

recovery point. To distinguish the breaking phase from the recovery phase, separate arrow lines are employed. An arrow line above the base line running away from the primary or "O" position with the number in diopters at the head of the arrow denotes the breaking point; another arrow line beneath the base line returning to the "O" position is used to indicate the

## 1. DEVIATION OR STATIC RESPONSE



## 2. VERGENCE OR DYNAMIC RESPONSE

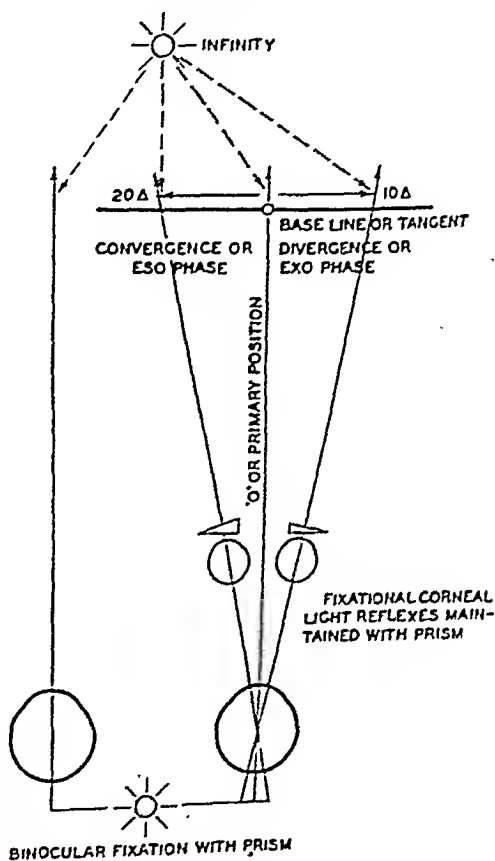


Fig. 1 (Krimsky). Graphic representation of binocular findings.

running in the opposite direction or back to the "O" position may serve to indicate the amount of prism required to recover fusion. In measuring for the breaking point we increase prism strength gradually until tolerance is no longer possible; by gradually reducing such prism strength, a point is gradually reached at which binocular hold can be restored. This is the

recovery phase, and the number in diopters at which fusion is restored is noted at the tail end of the arrow.

To make readings uniform, this base line was made to correspond to one eye rather than both, inasmuch as a prism effect over one eye is the same as if it were distributed equally before both eyes. If one arbitrarily places a rotary prism

before the right eye to make tests, then divergence would mean running an arrow to the right of "O" position; and convergence to the left of "O" position. This right-sided graph as a basis for recording binocular findings also simplifies the readings made with my stereoscope, which has its rulings beneath the right target holder.

The length of the arrows is an arbitrary matter. It would not be practical to employ a ruled line because the readings in some instances may be high and would therefore require an unduly long arrow line. A crude representation with emphasis on relative rather than actual values is sufficient. The course of the arrow lines should tell the examiner at a glance whether the fusion range is large or small; whether there is a proper balance between convergence and divergence; the relative extent of the breaking and recovery phases; and whether fusion in the "O" or primary position can be maintained without difficulty—in other words, whether a squint is absent.

If fusion is found to be absent in the "O" or primary position because of an obvious squint, the first aim is to ascertain that amount of prism or target displacement (as in the stereoscope) sufficient to correct or measure the deviation; or, in terms of corneal light reflexes, that amount of prism or target displacement required to bring the light reflexes to their fixation positions. The deviation is noted as a cross on the base line either in the convergence phase (ESO) or in the divergence phase (EXO) and the numerical value is written in prism diopters. It often happens that around this deviation position the patient will manifest a rudimentary fusion amplitude. Here, too, two arrows are drawn to indicate the manner in which prisms are being operated. Because fusion does not commence

at the "O" or primary position one should indicate with each arrow where fusion begins and where it ends. These readings are significant because: (1) They indicate a fusion amplitude that does not extend or cover the "O" position but merely is limited to either the convergence or the divergence phase. (2) They are helpful in prognosis because a rudimentary fusion amplitude with normal retinal correspondence suggests a more hopeful restoration of convergence and divergence after the eyes are straightened by surgery or other means.

It is readily conceivable that, if a manifest squint with a latent but residual fusion range can be improved by glasses, or by operation, or by binocular training, such displaced fusion range will likewise be shifted into the primary sphere of gaze to keep pace with the structural correction of the eyes. In other words, the patient will automatically develop a prism convergence and a divergence as in normal responses. By disregarding repeated binocular measurements and visual responses, too much credit may be attached to orthoptic training for binocular progress that may occur spontaneously in the occasional case after the eyes have been straightened by other means.

In more advanced cases of squint, this latent tendency to fuse at or around the angle of squint is lost and the base line is used to indicate by means of a cross the amount of squint (in prism diopters or degrees) or by objective angle (O.J.). Another cross may be employed to show the approximate position and reading of the subjective angle (S.J.), or where these images appear to touch or cross. Because there is no fusion amplitude, an arrow line cannot be used. This graphic picture is important in guiding the examiner to compare both objective and subjective responses after surgery or other means

have been resorted to in straightening the eyes. It also helps one in following up the effects of controlled binocular training.

A base or tangent line is used to indicate the binocular findings for one test distance. As a rule, most examiners select

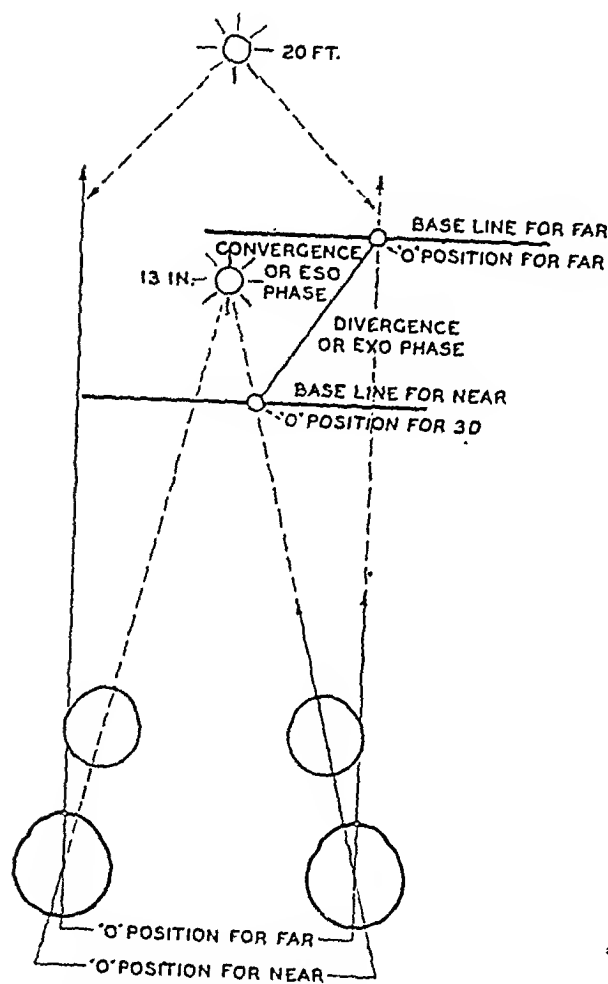


Fig. 2 (Krimsky). Composite graph for far and for near.

two test distances, 20 feet and 13 inches, respectively. This means two separate base lines, one for far and the other for near. To distinguish one from the other, I have set the 13-inch base line below the 20-foot or "O" accommodation line and have, moreover, displaced it to the left of the farther line to indicate the more relative convergence of the right eye for

near with shorter viewing distance; and have connected the "O" positions of these base lines to show the continuity of such tests (fig. 2).

A typical normal binocular response as noted graphically would read as follows (see fig. 3):

Literally, this would mean:

At infinity or "O" accommodation:  
*Divergence (abduction)*—breaking point,

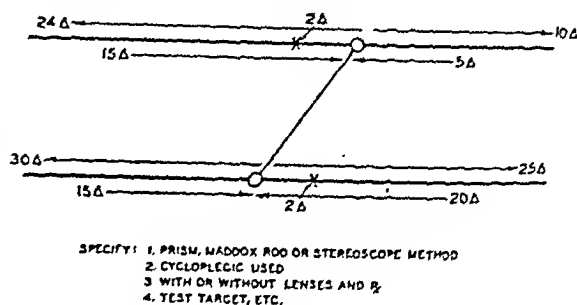
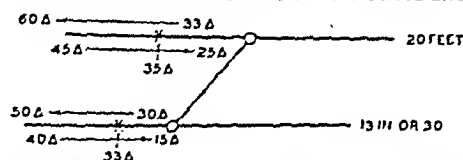


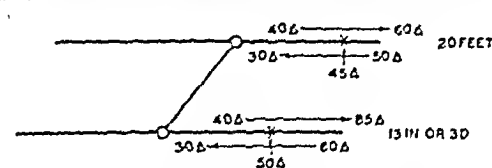
Fig. 3 (Krimsky). A normal binocular graph.

10 prism diopters; recovery point, 5 prism diopters. *Convergence (adduction)*—breaking point, 24 prism diopters; recovery point, 15 prism diopters. *Fusion am-*

#### 1 DIVERGENCE INSUFFICIENCY & CONVERGENCE EXCESS



#### 2 CONVERGENCE INSUFFICIENCY & DIVERGENCE EXCESS



#### 3 DIVERGENCE EXCESS (FOR FAR) & NORMAL FOR NEAR

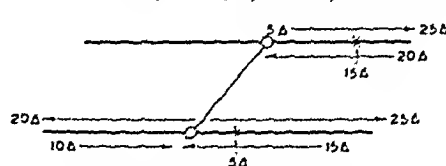


Fig. 4 (Krimsky). Abnormal graphs.

*plitude*—24 plus 10 or 34 prism diopters.

*Phoria*—2 prism diopters esophoria.

At 3D. Accommodation—Breaking point, 25 prism diopters. *Divergence (abduction)*—recovery point, 20 prism diopters. *Convergence (adduction)*—breaking point, 30 prism diopters; recovery point, 15 prism diopters. *Fusion amplitude*—25 plus 30 or 55 prism diopters. *Phoria*—2 prism diopters exophoria.

A few abnormal responses are also noted graphically:

### 1. Divergence Insufficiency and Convergence Excess (fig. 4, 1)

Interpretation of graph—

The cross on the upper base line indicates 35 prism diopters of esotropia for far; the cross on the lower line, 33 prism diopters of esotropia for 3D. accommodation. The arrow lines extend only in the ESO or convergence phase and do not touch the "O" or primary position. In other words, whatever fusion amplitude does exist is limited to the region of the deviation.

If this arrow line or its fusion amplitude can be made to shift either through surgical, refractive, or orthoptic means to the "O" position and beyond it to cover the divergence phase as well, one can follow at a glance the progressive improvement and observe how a manifest squint is gradually changed to a latent squint.

### 2. Convergence Insufficiency and Divergence Excess (fig. 4, 2)

Interpretation of graph—

The cross on the upper base line indicates an exotropia in the distance or so-called divergence phase of the eyes, and in accordance with accepted terminology is diagnosed as divergence excess; the cross on the lower base line denotes an

exotropia in the nearer or 3D. accommodative range. This is called the convergence range, and, because the eyes turn out markedly (to 50 prism diopters) when they should turn in, this condition is classified as a Convergence insufficiency.

Here too the arrow lines do not extend to the primary or "O" position and, therefore, point to an absence of fusion in the primary position; and to a divergent squint for near and for far with a rudimentary fusion amplitude limited to the divergence phase in the region of the deviation.

### 3. Divergence Excess (or squint for far) with Normal Response for Near (fig. 4, 3)

Interpretation of graph

The cross on the upper base line points to a moderate amount of squint with a fusion amplitude that is confined solely to the divergence phase, but extending so near to the primary position that it would seem that possibly binocular training should extend these arrows to cover the "O" position and the convergence phase as well.

The lower base line indicates 5 prism diopters of exophoria rather than exotropia because prism vergence covers both divergence and convergence. The low amount of exophoria is a normal response. This is likewise true of the fusion amplitude or arrow lines.

## CONCLUSIONS

1. A simple line graph may be used to provide a ready-reference picture of binocular findings.

2. A graphic representation of binocular findings presupposes a basic understanding of normal and abnormal binocular responses.

3. Two simple lines for far and for near

may form the basis for such a graph, and therefore can be inserted in any record card.

4. For purposes of simplicity, a base line adapted arbitrarily to either eye may be employed to record disturbances involving both eyes.

5. A simple graph enables the examiner to tell at a glance both for far and for near: (a) the phoria or deviation status; (b) the duction or fusion status in its various components; (c) the visual projection status—true or anomalous; (d) the vertical status.

6. The recovery phase in binocular measurement is as important as the breaking phase. While the breaking phase is important in indicating the limit of fusion amplitude, the recovery phase portrayed graphically indicates the extent through which fusion can be maintained with the least effort. The phoria point will be found

to lie at some point in the recovery phase.

7. A binocular graph is of value not only in the rapid estimation of abnormal responses but also in prescribing training for the particular type of deficiency.

8. Inasmuch as binocular readings vary under different conditions, such as the method of examination, the wearing of glasses, the direction of gaze, the examiner should specify on the graph the conditions under which tests were carried out.

9. A binocular graph is not a conclusive estimate of binocular findings but merely a combination of numerical readings obtained under specified conditions. It is for the individual examiner to evaluate the importance of such a graph in combination with other clinical tests, or repeated tests.

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# NOTES, CASES, INSTRUMENTS

## LIPAEMIA RETINALIS

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Lipemia, fat in the blood, occurs in either the globular or emulsified form. The globular form occurs when the gross particles of fat are free in the blood stream in such condition that fat emboli can result. In the emulsified form the fat particles are very small and are present in the blood in the form of a true emulsion. The present report deals with this form. Fat in the blood may be either normal or pathologic. A small amount may be present in the blood at any time, and there is usually some present after meals. The term *lipemia* is reserved for the status in which the quantity is of sufficient concentration in the blood to alter its appearance. It occurs in a variety of conditions, including diabetes, alcoholism, starvation, phosphorus poisoning, pneumonia, peritonitis, xanthomatosis, and leukemia. When the condition becomes sufficiently marked to be seen ophthalmoscopically the fundus picture is known as lipaemia retinalis. In the 60 cases previously reported only 2 were not associated with diabetes. One patient (Wagener, 1922) had leukemia and had undergone previous irradiation treatment. The other case was in an undernourished child, aged one year.<sup>1</sup>

Milky serum was known before the nineteenth century. Several case reports had been published, and in 1798 Rollo, of London, wrote a treatise on the subject. Heyl<sup>2</sup> reported the first case of lipaemia retinalis in this country, from Philadelphia, in 1880. He read a paper on the subject before the American Oph-

thalmological Society in the same year. The fundus picture is striking and characteristic. The change in color of the vessels begins in the periphery, and the small vessels appear flat and ribbonlike, and there is practically no difference between the arteries and the veins. The color at first is salmon pink; later its tint becomes creamy, almost yellow. The vessels look as though they contained a rather pale chocolate milk. The subsidence takes place in the reverse order. The condition is quite fleeting, lasting a day or two, but it may last as long as 8 or 10 days.

The blood lipid level necessary to produce a lipaemia retinalis varies considerably. The condition is apt to appear when the lipid content is 3.5 percent and to disappear when it falls below 2.5 percent. However, in one case quoted by Duke-Elder, lipaemia retinalis was present with a lipid content of 9.5 percent and had disappeared when it rose to 10.5 percent. McKee and Rabinovitch had a patient in which the condition disappeared when the fat content was lowered to a level between 1.42 and 1.13 percent. The lipids present usually consist largely of fatty acid, glycerides, cholesterol, and phospholipids. Marble and Smith,<sup>3</sup> in 1936, were among the first to report detailed studies of total lipids, fatty acids, cholesterol, and phospholipids in two cases. The total lipid content of the blood was 14.1 percent in the first case and 7.5 percent in the second. By far the largest increase took place in the fatty-acid fraction. Next in order of relative increase was the cholesterol, and third the phospholipid fraction. They do not state at what levels the characteristic fundus picture disappeared.

Recently McKee and others<sup>4</sup> have reviewed the literature and reported another

\* Read before the Section on Ophthalmology, College of Physicians of Philadelphia, December 17, 1942.

case of their own with detailed chemical analyses. Their patient was a white man, aged 22 years, a diabetic admitted in acidosis. He also had multiple xanthomata. The patient's total fat on admission was 8,439 mg. per 100 c.c., cholesterol 704, and phospholipids 1,427. The fundus appeared as practically normal when the total fat had dropped to 2,751, cholesterol 670, and phospholipids 487. They believed their case to be the sixtieth reported in the literature. I have two cases to report.

*Case 1.* H. K., a colored male, aged 25 years, had had several previous admissions to the Abington Memorial Hospital prior to the present admission on July 8, 1941. His diagnoses on previous admissions had been alcoholic gastritis and vascular hypertension. He was not considered to be diabetic. His blood sugars had not been over 118 and his fasting blood sugars had been within normal limits. His blood pressure in October, 1940, was 140/108, and in December, 154/100. Reduced caliber of the retinal arterioles but no other fundus abnormalities had been noted on these previous admissions. His alcoholism had dated back to September, 1939. The admission on July 8, 1941, was again for symptoms of gastritis complicating his alcoholism.

The eyegrounds of the two eyes on the day of admission were similar. The media clear, the optic discs were well defined and of good color. Near the disc all the vessels had a brick-red appearance, becoming paler toward the periphery, where they were almost white, there being two faint white bands with a narrow, pale brick-red band between them. The arteries and veins were similar in appearance. No exudates nor hemorrhages were seen. The following day the characteristic picture of lipaemia retinalis had entirely disappeared. The picture was then

one of reduced caliber of the retinal arterioles with no other abnormalities. On admission his blood sugar was 110; plasma,  $\text{CO}_2$ , 60; NaCl, 510; B. U. N., 14; cholesterol, 960. The second day after admission, when the fundus picture had returned to its previous state, the cholesterol was 980; eight days after admission it dropped to 486. Other chemical determinations were not made.

*Case 2.* E. H., a white woman, aged 22 years, was given a diagnosis of lipaemia retinalis on November 9, 1940, the day after her admission. She had had a long and stormy diabetic history, beginning in 1930. During the 10 intervening years she had been admitted to the hospital at least 16 times for conditions complicating her diabetes. Usually, the patient was in acidosis and sometimes comatose on admission. She had been very difficult to keep under control, partly because of not too intelligent coöperation, but probably also on account of the complicated nature of her condition. She had frequent infections such as aveolar abscesses, perirectal abscesses, and grippe. What would have been a minor episode in most diabetics even, was a major crisis for her. She had required insulin approximating 75 units a day. Her eyegrounds had always been normal until her admission on June 10, 1940, when a beginning retinosis was noted. Her present admission, November 18, 1940, followed about three weeks after a fall downstairs, contusing her lumbar spine. She had been off insulin for two months and was being treated by diet alone, maintaining a blood sugar from 120 to 130. This was the first time in 10 years that she had been able to go without insulin. She was not in coma on admission. Her blood pressure varied from 130 to 150 systolic and from 90 to 100 diastolic during this hospital period which lasted  $2\frac{1}{2}$  months. On the afternoon of her admission her blood



sugar was 312, but her fasting sugar was 110 next morning; plasma NaCl, 528; cholesterol, 1, 216; plasma CO<sub>2</sub>, 50. Her first urine specimen was slightly acid and the second was neutral in reaction; serum albumin, 2.46; globulin, 2.16. Her cholesterol gradually rose from day to day to 2,300 on November 25th. From that point it gradually fell to 484 on December 23, 1940, but rose again to 526 on January 21, 1941. Calcium and phosphorus determinations on November 23, 1940, were both within normal limits. A single total lipid determination on November 29, 1940, 11 days after admission, was 7.78 percent. At this time the lipaemia retinalis was still diagnosable, but was definitely receding.

To go back to the fundus picture: On November 19, 1940, the media of the right eye were clear and the disc was well defined. There was slight cupping. The veins were full, pale, and milky, exhibiting slight pressure at crossings. The arteries were pale, bright, brick red in color and flat in appearance. The entire fundus was studded with hard exudates and a dozen or more small, round, and a few spindle-shaped hemorrhages. The entire fundus background was milky. In the left eye the condition was grossly similar with more marked vessel changes and definite edema around the posterior pole. The lipemic picture in the fundus remained for several days, but on November 23, 1940, it was noted to be disappearing, although the condition was still diagnosable in the periphery. On November 24th, the best visual acuity was 6/22 in the right eye and 6/30 in the left. The peripheral form fields were very nearly normal, but the patient was definitely blind to blue throughout for 10-mm. objects at 33 centimeters.

Her fundus picture on November 30th, was: O.D., media clear; disc blurred by peripapillary edema; color good; veins overfull and very irregular in caliber,

pale but not milky, showing marked pressure at crossing. The arteries were very thin, irregular, and bright. The fundus was strewn with irregular confluent masses of exudates and a few petechiae. The arteries again showed the normal central light streak; the flat ribbonlike appearance was gone. The left eye was grossly similar in appearance to the right eye, but there were more exudates, especially along the superior temporal vein. This vein was very irregular in caliber, with marked thickening of the vessel wall. Venous return in the superior temporal vein was so slow and scant as to permit streaming to be visible. The condition changed very slightly until a few days before the patient's discharge on January 1, 1941. At this time streaming was still present in the left superior temporal vein, and proliferating bands of connective tissue were becoming visible.

During the hospitalization period afore-described, a laparotomy was performed on December 16, 1940, to rule out the possibility of a pancreatic tumor. This was suspected because of her lower insulin requirements and quite marked abdominal distress. Soon afterward this patient developed glaucoma in the left eye, and then in the right. All medical and surgical treatment for this condition has been of no avail and the patient is now living but completely blind. The left eye, after several surgical procedures, has now reduced tension. The pain from the glaucoma in the right eye has been controlled by a retrobulbar injection of alcohol.

#### DISCUSSION

Two cases of an unusual condition, both presenting some interesting and unusual features, have been described. The first patient was definitely not a diabetic. This apparently is the third case of lipaemia retinalis in the literature in a nondiabetic patient. The second patient had a marked degree of retinosis, which, according to

Duke-Elder is unusual among these patients. Over 80 percent of the cases occur in patients who are approaching coma or are in a state of coma. Neither of these patients was in coma, although the young woman had been in coma on several previous occasions. Acidosis is said to be present in all of these cases. In the two patients here presented the  $\text{CO}_2$  combining power of one was 50, and of the other 60. The urines were only slightly acid or neutral in reaction and contained no ketone bodies. This, however, is no proof that they were not at least slightly acidotic. The only way to ascertain this would be to obtain a simultaneous determination of the pH of the patient's blood serum. This was not done.

The exact factor or factors which cause lipemia to become visible in the retina have not been determined. Obviously the total lipid concentration is an exceedingly important factor, but the visibility in the retina does not always appear or disappear within the same range of lipid concentration. Similarly it does not seem possible to establish satisfactory correlation

of visibility with changes in concentration of the various lipid fractions. It would seem that the degree of dispersion is a most important factor. As the particle size of the dispersed phase increased we might expect recognition through the vessel walls. Aside from the factors primarily responsible for the production of the lipemia, the particle size and homogeneity of the dispersion will be influenced by the electrolytic character and concentration, the pH, and the presence of other colloidal materials in the plasma.

I am greatly indebted to Dr. Charles Grosscup, chemist at Abington Memorial Hospital, for his help. The suggestion made above is based upon conversations with him about the physio-chemical principles, involved in the subject under discussion. The cases presented were from the Medical Service of Dr. George Morris Piersol, the Metabolic Division of Dr. Joseph Beardwood. My thanks are due both of them for the privilege of making this presentation.

*Medical Arts Building.*

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#### "THROUGH EVIL, GOOD"

GUERNSEY FREY, M.D.  
*New York*

Large numbers of cases of epidemic keratoconjunctivitis are being reported in communities across the American continent from coast to coast. In many instances, the patients are not industrial workers and there is no history of contact with other known cases. The suspicion arises that ophthalmologists themselves

may, at times, be responsible for the spread of the infection.

Where measures of therapy are of doubtful value, preventive medicine becomes of paramount importance. Many clinics and doctors' offices still use the old-fashioned dropper bottles for conjunctival instillations. This epidemic may at last be the means of eliminating this potent menace. The abolition of the ubiquitous dropper bottle is a reform which has been long overdue, and, where it has been ef-

fect, the change has caused no inconvenience. It is only necessary to replace the droppers with stoppers—the droppers themselves may be utilized as part of the supply of sterile droppers to be used afresh for each patient.

Where several drops of the same medicament are to be used in the same eye, as in the case of local anesthetics and mydriatics, a sufficient quantity may be drawn into the dropper at one time to suffice for the requisite number of drops. If one drop only is to be used, care must be exercised not to waste the solution by withdrawing more than the minimum amount to be used. Economy may also be practiced by the use of a glass rod to which one drop and no more of the solution will adhere by capillarity—a particularly good hint in the use of fluorescein and other dyes.

Although sterilizing kills germs, it does not destroy the chemical activity of all the various medicines used for eye drops, and it is therefore necessary thoroughly to wash and rinse eye droppers before boiling them. Even with this precaution, it may be advisable to have distinctive droppers for use with mydriatics and keep them separate from the others to avoid the occasional undesirable effect of contamination.

121 East Sixtieth Street.

## EYES RIGHT AND DOWN—NOT EYES DOWN AND RIGHT

THOMAS D. ALLEN, M.D.  
Chicago

From reading the literature and from contacts with graduate students, I have concluded that one of the great difficulties students and many practicing ophthalmologists experience in the comprehension of the functions and actions of the individual ocular muscles, springs from

our use of words. Instead of thinking of the primary position as the origin of rotations no matter which ocular muscle is stimulated, we should think of the three cardinal positions: 1, eyes straight; 2, eyes right; and 3, eyes left. From each of these positions as a starting point, only two muscles of each eye act in a simple, uncomplicated way.

1. Eyes straight
  - (a) median rectus
  - (b) lateral rectus
2. Eyes right
  - (a) superior rectus
  - (b) inferior rectus
  - (c) superior oblique
  - (d) inferior oblique
3. Eyes left
  - (a) superior rectus
  - (b) inferior rectus
  - (c) superior oblique
  - (d) inferior oblique

When we say "eyes right and down" we mean the attention is turned downward *from the eyes' right position*. From this position only one muscle of each eye moves the eye down; namely, the right inferior rectus and the left superior oblique. If we say "eyes down and right" we think of the eyes turning right *from the reading position*; that is, the movement to the right is emphasized by the statement; and this makes us think of the right externus and the left internus, not the right inferior rectus or the left superior oblique.

We cannot easily investigate the simple downward rotation of the right eye by having the patient look down first and then to the right. This is because 1, the reading position of the eyes is the result of the combined action (three muscles of each eye) of both of the depressors and of the internus of each eye, and, 2, the motion to the right from the eyes down position is the result of the action of the

right externus (and less so of the two obliques) and of the left internus (and less so of the superior and inferior recti).

In investigating the ocular muscles, the simpler the technique the more accurate the findings. For the median and lateral recti we start with the eyes in the primary position; for the left obliques we start with the eyes right, for the right obliques with the eyes left; and for the superior and inferior recti we start with the eyes toward the side of the eye under question. From the last two cardinal positions (that is, eyes right and eyes left) the eyes are directed upward or downward, respectively, to investigate the elevators or depressors.

May I therefore respectfully suggest that we change the phrase "down and right" to "right and down"; "down and left" to "left and down"; "up and right" to "right and up"; "up and left" to "left and up."

This is not the first time this subject has been brought to our attention; but it is worth repeating because of its extreme simplicity.

*122 South Michigan Avenue.*

# CLOSURE OF THE SCLERA AFTER REMOVAL OF INTRAOCULAR FOREIGN BODY BY THE POSTERIOR ROUTE

WALLACE C. BEIL, M.D.  
*New Orleans*

The point of incision of the sclera is selected, and the bulbar conjunctiva is incised, exposing the sclera. The sclera is incised through approximately two thirds of its thickness in a similar manner as for cyclodialysis. A piece of 6-0 silk on an atraumatic needle is placed through the two lips of the wound and the threads drawn up in a loop from the bottom of the wound (diagram). After completion of the incision, these can be used as trac-

tion sutures to make the wound gape for the insertion of instruments and the removal of the foreign body. After removal of the foreign body the ends of the sutures

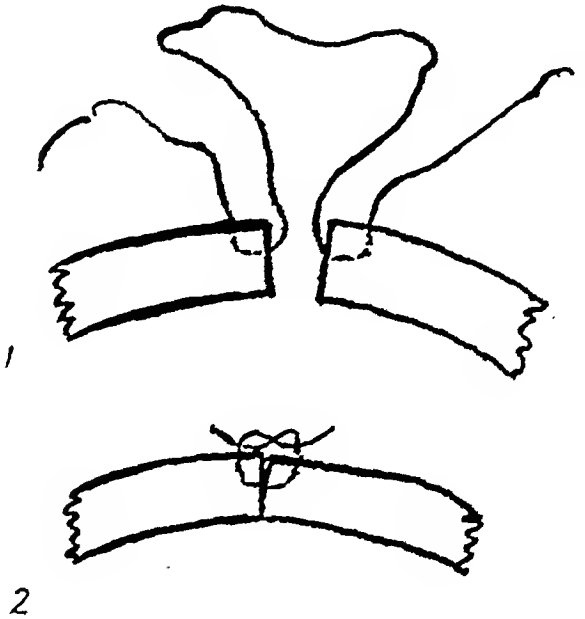


Fig. 1 (Beil). Cross section showing sutures used for traction.

Fig. 2 (Beil). Suture closing wound.

are drawn together and tied, giving a firm closure and, if cut short, can be left buried.

*812 Maison Blanche Building.*

# A NEW MATERIAL FOR ANTERIOR-SEGMENT IMPRESSIONS

H. SAUL SUGAR, MAJOR (MC), A.U.S.  
*Vancouver, Washington*

Technical advances in one field of science frequently lead to improvements in the methods used in other fields. Such has been and remains the case as regards materials for making impressions of the mouth prior to fitting artificial dentures, and in the making of impressions of the anterior segment of the eye for molded contact lenses.

The various impression materials used in the making of molded contact lenses in-

clude negocoll,<sup>1</sup> dental wax,<sup>2</sup> Kerr's hydrocolloid,<sup>3</sup> and more recently, a material known as zelex.<sup>4</sup> Boshoff, in his introduction of zelex, considered three properties necessary in an ideal plastic material for making such impressions: (1) rapid setting, (2) non-irritating, and (3) elastic and shape-retaining. A fourth property—namely, ease of preparation—might well be added. Negocoll and dental wax do not have the elasticity of zelex and the hydrocolloid and in addition are more time-consuming in their preparation. The material which I have used has the elastic properties claimed for zelex and Kerr's hydrocolloid and in addition does not require regulation of the temperature, as is necessary with all the other materials, including zelex. It is known commercially as Coe-loid Powder.<sup>5</sup> It is an alginate base composed of algin, calcium sulphate, and filler. When mixed with water it forms a highly elastic gel. The material has no damaging effect on the cornea, conjunctiva, or lids. The pH of the material I have used was 7.25. It is marketed as a fine pink powder in tubes containing 12 grams of the material. In each tube there is a capsule of white powder known as retarder. For each tube of material, 55 c.c. of water at room temperature (70°F.) is recommended for mixing. To conserve material I have divided the pink powder from a single tube into 6 packages of 2 grams each. In addition the retarder is divided into 6 equal parts by weight (13 grains) and placed into separate capsules. To make an impression of the anterior segment of an eye the contents of one capsule (subdivided retarder) is dissolved in 9 c.c. of water at room temperature in any type of container. A 2-gram quantity of the powder is added to the dissolved retarder and vigorously spatulated with a tongue depressor for two minutes. No more water is added. The cost of material for a single casting is approximately nine cents.

The process of mold-making requires anesthesia of the conjunctiva and cornea of the eye. Usually two instillations of either butyn (2 percent) or pontocaine (0.5 percent) and one drop of epinephrine 1:1,000 are used a few minutes before beginning spatulation of the impression material. Both eyes may be anesthetized to minimize blinking of the second eye, which is used for fixating. It has been suggested<sup>6</sup> that fixation should be such that the fixating eye is turned temporally and downward enough so that the lower edge of the pupil is in line with the top of the lower lid. This gives a good molding of the upper temporal scleral segment.

After two minutes of spatulation of the impression material the latter is transferred to a perforated plastic molding shell<sup>7</sup> and immediately applied to the eye. Setting occurs in about two minutes. The manufacturers give the following setting times including spatulation for two minutes: 65°F., 5'5"; 70°F., 4'20"; 75°F., 3'45"; 80°F., 2'45". After a total of three minutes of application, if setting has occurred, the shell is removed, first from the lower cul-de-sac, then the upper. The mold is immersed for 10 to 15 minutes in a fixing solution made by dissolving a tablet of fixing material (which accompanies the tube of Coe-loid Powder) in 100 c.c. of water. (This solution may be used over again.) The excess water is carefully removed from the mold, care being taken not to touch it, and dental stone is poured into it from the side, preferably with the mold held on a dental agitator. The mold should not be removed from the stone until one hour after hardening. The nasal and temporal sides of each should be marked on the cast.

I have used the same material for making masks of the face and lids in studying cases before undertaking plastic procedures on the lid regions.

*Barnes General Hospital.*

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## REFRACTION CLINIC\*

DISCUSSION BY ALBERT E. SLOANE, M.D.†  
*Boston*

A housewife, aged 36 years, claims difficulty in reading with her present glasses.

## EXAMINATION

Naked vision in each eye was 20/20. She was wearing for each eye a +2.00D. sphere.

Refraction was attempted without cycloplegia and the House Officer made this note: "Retinoscopy varies considerably, so that a reading cannot be obtained. A +2.50D. sphere blurs the patient to 20/100 and in the next moment the patient is able to see 20/20 with the same glass. This holds true with lenses as high as +6.00 diopters."

Cycloplegia was ordered.

When reexamined (this time with homatropine) the patient accepted: O.D., +3.75D. sphere; O.S., +4.00D. sphere.

The House Officer, however, noted that even with this prescription vision would blur and then clear to 20/20.

## DISCUSSION

A 36-year-old person has 20/20 vision without glasses. This would indicate either an emmetropia or the presence of hypermetropia. Astigmatism may be present with the hypermetropia but is

probably not high because the naked visual acuity is so good.

At 36 years of age the accommodation is quite active so that the hypermetropic error can be fairly high. We note that the patient is wearing +2.00D. sphere, but in spite of this has symptoms at near. This would suggest one of two possibilities: Either the refractive error is inadequately corrected, or a muscle imbalance is present. Since no data are given concerning a muscle imbalance, we will assume that none is present. The variable findings of visual acuity with a constant lens and the variable degrees of refractive errors noted by retinoscopy indicate that the crystalline lens is changing its curvature and that some sort of spasm of accommodation is present. The House Officer showed good judgment in ordering cycloplegia in spite of the patient's age.

Under cycloplegia we will note that even with the lenses found (O.D., +3.75D. sphere; O.S., +4.00D. sphere), vision at times would blur and then become normal. This would indicate that the cycloplegia has not completely done away with the activity of accommodation, and that probably there still remains some latent hypermetropia. This is not uncommon when the cycloplegia used is homatropine and is more likely to be the case if the homatropine is not given in sufficient quantity and if enough time is not allowed between the last instillation of the drops and the examination.

For the purpose of this case, it is not

\* From the House Officers' Teaching Clinic, Massachusetts Eye and Ear Infirmary.

† Director of Department of Refraction.

essential that we know the total refractive error since enough latent hypermetropia has been uncovered, even with an incomplete cycloplegia, to explain the symptoms.

#### SOLUTION

I have found it most expedient not to correct fully people who have high latent hyperopic errors in the presence of a hyperactive accommodation. Patients do much better if one gradually increases the convex power as the symptoms demand. A full correction may be well tolerated at near, but will produce a marked blurring of vision at distance. I generally advise the patient that it will probably be necessary to change his glasses more often than in the average case and ask him to return for another correction at no more than yearly intervals, and, of course, oftener if symptoms demand.

In this particular case I would suggest, as a prescription, lenses with a dioptric value half-way between the glasses previously worn and the new findings. A desirable prescription might then well be O.D., +3.00D. sphere; O.S., +3.25D. sphere. (*Note:* We, of course, assume that our findings need not be influenced by any muscle imbalance.)

House Officer: You are not, then, making any deduction for the homatropine?

Dr. Sloane: This may be answered in two ways. First, a deduction is being made, and if you choose to refer to it as for the homatropine, well and good. Second, we can safely assume that the total refractive error is higher than the amount shown, so that the homatropine does not require that we reduce the plus value since it did not uncover the entire error.

H. O.: Would it be feasible to allow her to keep her old glasses for distance and give her the full findings as found by homatropine for near?

Dr. S.: I would say that that would be a satisfactory solution as the patient had a great deal of discomfort in using the eyes at near. But the objection would be that she would then require two pairs of glasses, which, at best, is inconvenient. (*Note:* Wherever it is possible to give a patient one pair of glasses for all purposes, that should be the procedure of choice.)

H. O.: Is it ever impossible for a person to see clearly with convex lenses at distance, in such cases, due to a hyperactive accommodation?

Dr. S.: Occasionally you will have a patient who will be unable to tolerate a distance plus correction in spite of a high latent hyperopic error. Such persons will always do well if they will wear their glasses long enough, but they can be helped to make the adjustment if one gives them small amounts of a cycloplegia for several days a week. For example: You might prescribe homatropine to be used three times a day or weekends when they do not have to work. Incidentally, there is a "pointer" I can give you on that. A child who has never worn glasses and who has convergent strabismus, with a moderately high hyperopic error (about 3 diopters), will frequently refuse to wear his glasses because he will see more clearly without them. You can train that child to wear his glasses if you will have a cycloplegic instilled once daily for the first few weeks that he has his new glasses.

#### PERIODIC DIVERGENCE (EXOTROPIA) DUE TO DIVERGENCE EXCESS

A girl, aged 11 years, reported for examination and was concerned because one of her eyes diverged at times. She did not ordinarily see double, but could easily make herself do so.

P.P. Convergence—7 cm.: distance,

12<sup>A</sup>-30<sup>A</sup> variable exophoria; near, 12<sup>A</sup> exophoria.

Retinal correspondence, normal.

Ductions: Distance—adduction, variable; abduction, variable. Near—adduction, 20<sup>A</sup>; abduction, 16<sup>A</sup>.

#### EXAMINATION

Refraction showed a negligible hyperopic error. The p.p. convergence was 7 cm. With the Maddox rod at distance the patient manifested a variable exophoria of 12<sup>A</sup>-30<sup>A</sup>, and at times would lose one image. At near she consistently showed 12<sup>A</sup> exophoria. There was no vertical heterophoria. Retinal correspondence was normal as tested with the afterimage test.

*Cover test.* There was no binocular vision at distance. When the cover was over the right eye, this eye turned out and remained out even when the cover was removed. This held true when the test was made with the cover before the left eye also. However, when tested at near fixation, the occluded eye turned out but promptly returned to participate in fixation when the cover was removed.

Ductions with distance fixation were variable and unreliable since suspension of vision occurred easily in one eye. At near, ductions could be taken and showed: adduction 20<sup>A</sup>, abduction 16<sup>A</sup>.

#### DISCUSSION

This patient had a periodic exotropia, which could be determined by the history of her occasionally turning one eye out. It was further borne out by the cover test, which showed binocular vision at near but not at distance. Since there was no diplopia, it may be assumed that this was no longer a high exophoria, but rather an exotropia. There certainly was no refractive basis in this case for the divergence, since the error was reported as negligible. There was no difference in vision between the two eyes to explain the exotropia. Therefore the tropia could be due

to either an insufficiency of convergence, or an excess of divergence.

Let us consider the status of convergence: The p.p. convergence (7 cm.) was well within normal limits. If the convergence were inadequate we would expect the divergence to be more marked at near. In this case the divergence was more marked where convergence was least required; that is, at distance. Since this person had learned to overcome a diplopia at distance by suspending one eye, reliable duction readings could not be obtained, which naturally requires the participation of both eyes. If this had been possible, no doubt we would have found a more or less normal adduction and a high abduction. The ductions could be obtained at near because there was single binocular vision upon near fixation, and here the abduction and adduction were fairly normal. The diagnosis therefore was: Periodic exotropia due to divergence excess.

#### SOLUTION

One immediately wonders, if the divergence excess factor could be neutralized, would single binocular vision obtain to hold the result? We can assume that the chances are good for binocular vision to be present for distance after the divergence difficulty is neutralized, provided that the habit of suspension has not been too deeply ingrained. Thus, recent cases are more amenable to treatment than those of long standing.

The normal retinal correspondence is very helpful intelling us:

1. This is not an exotropia on a congenital basis
2. Fusion-training is not impossible

Conservative measures, using prisms, are ordinarily not successful because the prisms must be very strong (about 20<sup>A</sup>) and also because those prisms which would theoretically neutralize the error at dis-



tance would introduce difficulties at near where none had previously existed. Another conservative measure is the use of minus lenses. This has been tried with the idea that stimulating accommodation for distance would stimulate convergence to neutralize the exotropia. This does not work because a minus lens that is theoretically strong enough to do this cannot be tolerated at distance, let alone at near. Conservative measures utilizing orthoptics are not effective because you cannot readily train an overacting function to underact. The best treatment is surgery followed up by orthoptics. Weakening procedures on the external recti are indi-

cated and are advantageously followed up with orthoptics which do not allow the use of accommodation during the training period. Frequently, simply removing the divergence excess is sufficient to restore binocular function since whatever we look at may serve as stimuli in an orthoptic sense. If the retinal correspondence is anomalous, the operative procedure is the same, but the likelihood of obtaining binocular vision with fusion is not good. In those cases where the retinal correspondence alternates between normal and anomalous, the prognosis must be guarded, although it is not hopeless.

*243 Charles Street.*

## SOCIETY PROCEEDINGS

EDITED BY RALPH H. MILLER

### CHICAGO OPHTHALMOLOGICAL SOCIETY

April 20, 1942

SANFORD GIFFORD, *president*

#### CLINICAL MEETING

(Presented by Staff of Children's Memorial Hospital)

#### BILATERAL METASTATIC ENDOPHTHALMITIS

DR. R. C. GAMBLE said that M. G., a girl, aged five years, was admitted to the hospital on May 14, 1941, with fever, nausea, vomiting, and abdominal pain. She had numerous small hemorrhages in the skin which rapidly increased in extent. The original diagnosis was purpura, but after 48 hours the neck was rigid and the spinal fluid contained 2,800 cells and meningococci, and the diagnosis of meningitis with an unusually marked cutaneous reaction was made. At this time the vitreous of each eye was very cloudy. The patient was sent to the Mu-

nicipal Contagious Diseases Hospital where she was given meningococcus antitoxin and sulfapyridine. On June 6th she returned to Children's Memorial Hospital for further treatment of the eyes.

At this time the right eye showed ciliary injection, many white precipitates on the posterior surface of the cornea, and a diffuse haze in the vitreous, with one large opaque strand of solid material on the nasal side. The left eye showed ciliary injection, and the vitreous was entirely filled with exudate.

Treatment with sulfapyridine caused a marked urticaria, and this medication was discontinued. The precipitates and vitreous haze in the right eye gradually disappeared during the next two weeks. The exudate in the vitreous of the left eye broke up into small masses and gradually changed to wavy strands, finally disappearing; there remains some translucent opacity in the central canal of the vitreous. Vision R.E. 20/30, L.E. 20/40.

This is the first case under observation

at Children's Memorial Hospital in which recovery with vision has occurred. Formerly, 8 or 10 cases a year were seen, some of which, unfortunately, were bilateral. The incidence of the ocular complication definitely became less when meningococcus antitoxin came into use instead of intraspinal antimeningococcus serum. When sulfapyridine was used routinely, metastatic endophthalmitis was no longer seen. This case demonstrates that sulfapyridine is of curative value even when the eye condition has become established.

#### SOME OCULAR ASPECTS OF HEAD INJURIES

DR. ADRIEN VERBRUGGHEN (by invitation) read a paper on this subject.

#### OPTOCHIASMIC ARACHNOIDITIS: REPORT OF THREE CASES

DR. EDWARD R. RYAN read a paper on this subject.

Robert Von der Heydt.

### COLLEGE OF PHYSICIANS OF PHILADELPHIA

#### SECTION ON OPHTHALMOLOGY

April 16, 1942

ALFRED COWAN, M.D., *chairman*

#### TOTAL BILATERAL BLINDNESS DUE TO LESIONS IN BOTH OCCIPITAL LOBES

DRS. J. C. YASKIN and A. TORNAY reported that homonymous defects due to unilateral lesions in the geniculocalcarine tract were quite common but that bilateral lesions were rare. Bilateral lesions were observed in Schilder's disease and in vascular, neoplastic, and traumatic lesions of *both* occipital lobes. If both occipital lobes were completely destroyed, total blindness results.

According to Marquis (Ass. Res. Nerv. and Ment. Dis., 1932, v. 13, p. 558) only

nine cases of complete blindness from bilateral cerebral lesions had been reported up to 1932. Hemphill (Irish Jour. Med. Sci., 1941, v. 181, Jan., p. 28) reported two cases of sudden complete blindness due to the occlusion of both posterior cerebral arteries. If the occipital poles are spared, central vision may remain intact. There was some evidence that in some cases the occipital pole was supplied by branches of both the middle cerebral and posterior cerebral arteries, and in vascular lesions the branch from the middle cerebral arteries could be spared, thus accounting for the preservation of macular vision.

The first case was that of a woman, aged 64 years, who, following the death of her husband, developed a variety of complaints that were regarded as neurotic. When first examined, on June 7, 1939, there was a history of complete loss of vision in both eyes. The sight in the left eye had begun to disappear about six weeks previously and was completed in about three weeks, and in the right eye in the past two weeks. The fundi and other ocular studies gave evidence of no abnormalities, and at first the blindness was regarded by some as hysterical. At first no neurologic abnormalities were observed, but in the course of two months there appeared a left facial palsy, signs of bilateral pyramidal-tract lesions, a slow pulse, an increase in spinal-fluid pressure, and enlarged glands in the neck. X-ray evidences pointed to a carcinoma of the stomach. The patient died at home and no autopsy was procured. It is reasonable to assume that she had metastatic carcinoma of both occipital lobes.

The second case was that of a syphilitic colored man, 51 years old, who had gradually lost his vision in the course of the past two years so that he had been completely blind for the last few months. On February 16, 1942, three days prior to

his admission to the Philadelphia General Hospital, he developed a left hemiplegia. Examination disclosed a blood pressure of 190/150, cardiac enlargement, a flaccid left hemiparesis and hemihypalgesia, normally reacting pupils, and, according to Dr. J. B. Rudolphy, no ophthalmologic findings to account for his total blindness. The autopsy showed extensive softening of both occipital lobes.

Both patients were completely blind, exhibited loss of reflex lid closure to light illumination, had adequate reaction of pupils to light stimulation, and presented no abnormalities of the fundi to account for their blindness. It must be assumed that in both cases the occipital lobes were completely destroyed: in the first by a neoplasm, in the second by vascular softening. From a neuropsychiatric standpoint it is worth stressing that the first patient's case was regarded for several weeks as one of "hysterical blindness."

*Discussion.* Dr. J. B. Rudolphy commented that he had seen the second patient just prior to the time he died. As a matter of fact, the patient died just after his examination, and was in such a condition that they could not learn much about his extraocular movements. The patient's lateral rotations were full and his pupils had been dilated by means of homatropine, so he could not tell whether they reacted or not, but, according to a previous examination, they had reacted.

An ophthalmoscopic examination revealed no neuritis, no papilledema, and no atrophy. The vessels were sclerotic to a very great degree. The fact that the ophthalmoscopic examination showed no pathologic changes in the optic nerve and that the patient was absolutely blind binocularly, left no doubt that the lesion was within the visual cortex, occupying both occipital lobes.

Absence of papilledema and atrophy indicated that the lesion was probably a

degenerative process rather than a tumor or space-taking lesion.

Dr. M. H. Langdon asked Dr. Yaskin a question about his first case. As he remembered it, Dr. Yaskin said that one eye went blind some weeks before the other, and hemianopsia was not mentioned. How did he account for a bilateral occipital-lobe lesion when one eye went blind three or four weeks before the other, and the other went completely blind with both halves of the visual field apparently involved simultaneously in each eye? It seemed to him a peculiar occipital-lobe development.

Dr. J. C. Yaskin answered that when the patient reached him she was completely blind. When seen by her ophthalmologist, she complained of blindness in one eye, but apparently no fields were taken at the time of this complaint and he did know that the ophthalmologist made a diagnosis of a vascular arteriosclerotic lesion of the optic nerve. When referred to him, the patient was completely blind. Her condition had been diagnosed as hysteria by this ophthalmologist and by others as well. He had no doubt that had fields been taken when she had this so-called blindness in the left eye, a hemianopic cut would have been found.

Dr. M. H. Langdon thought there was a great deal of assumption.

Dr. J. C. Yaskin did not believe that it was assuming too much. They often encounter supratentorial tumors with hemianopic cuts that had been overlooked unless careful fields were taken. Indeed, they sometimes saw cerebellar tumors which grew so large as to produce pressure through the tentorium and give rise to confusing hemianopic defects. On the other hand, he believed blindness was often ascribed to rather insignificant changes in the retina, just as papilledema was often diagnosed on too little evidence. Moreover, he believed that the

neurologist assumed a great deal less than did other specialists.

### HYDROPHTHALMOS

DR. I. S. TASSMAN reviewed the subject of hydrophthalmos briefly and presented three cases. The factors stressed in the condition were the hypertension of the eyeball and its relationship to the enlargement; the structural alterations that were said to be present in the angle of the eyes of these patients; the importance of early operative treatment, especially the choice of a trephining operation; and, lastly, the association in some of these cases of other changes, such as thickening and enlargement of the bones of the skull.

Three cases were presented, all in males. The first occurred in a boy, six-years old, in whom the right eye alone was affected, the left eye being normal. The cornea of the right eye measured 18 mm. in diameter. This patient was first seen at the age of five months, but was not operated on until he was four years old, when an Elliot trephining was performed. Intraocular pressure in the right eye was now 23 mm. Hg. The disc showed a glaucomatous cup and optic atrophy. Vision was nil. The case was otherwise uncomplicated.

The patients in the other two cases were first seen at the age of 7 months and 12 months, respectively. Both were large, unusually well developed for their age and both revealed an unusually large head, although probably not pathologic. The intraocular pressure ranged from 40 to 45 mm. Hg in each eye of both patients. The condition was bilateral in each. All four corneas were 18 mm. in diameter. Opacities were present in each. In one, the photophobia was so marked that the patient buried his head in a pillow throughout the entire day to avoid light.

This patient was operated on, both eyes, in July, 1941. At the present time,

there is a marked improvement in the vision and almost an entire absence of photophobia. The patient walks about alone and in almost any light. He is a much happier and improved child at this time.

The other child had practically no photophobia, but in all other respects was similar to the former. He had not as yet been operated on, but an Elliot trephining operation was to be performed at this time.

Special emphasis was placed on the unusually large cranium and unusual muscular and physical development in association with the hydrophthalmos in the two latter cases, and the marked improvement in the ocular condition which was obtained in the one patient who was operated upon.

*Discussion.* Dr. W. E. Fry said these cases of hydrophthalmia made up a fair proportion of the students at an institution such as the Overbrook School for the Blind. At this school slightly less than half of the youngsters were there because of blindness connected with some congenital or hereditary defect, and of that group there were now 22 boys and girls who had hydrophthalmos. Of these 22 he thought 13 were boys and 9 were girls, indicating a more frequent occurrence in boys, but certainly not predominantly so.

Nearly 8 percent of the youngsters were there because of hydrophthalmos. Most of them were either entirely blind or had only light perception. In a recent survey of the records Dr. Fry found that only one youngster with hydrophthalmos had had any recordable vision at all; namely, 1/150. The rest were either blind or had only light perception. Many of them had had one eye enucleated, and some of them had had both eyes enucleated, because being prominent, they were subject to trauma. They bumped into corners of doors or any object that might

be in their way. Such eyes rupture very easily, and a number of them had had to be removed on this account.

Only 5 of those 22 had been operated on to relieve the intraocular pressure; most of the operations had been trephining. In spite of the fact that the prognosis was poor, and in spite of the fact he could not quote better figures on operations, it was Dr. Fry's belief that these youngsters should be operated on. In all probability even though vision was not retained permanently it might be retained over a longer period of time.

They were an interesting group to study as far as the ophthalmologic changes were concerned, but the prognosis for vision is poor.

Dr. M. H. Langdon stated that one of Dr. Tassman's cases was interesting to him, because it was the first unilateral case of buphthalmos or hydrophthalmos that he had ever seen. He thought that some of the cases that occurred unilaterally and seemed to be hydrophthalmoses were very probably due to a birth injury. He had seen one case of a glaucomatous eye in a child, but in view of the fact that there was a mark across the forehead and also the eyeball of the child, there was good reason to suspect ocular injury at birth. There was a secondary glaucoma due to this, and not a true congenital malformation resulting in the stretching of the globe.

Some discussion of the evening had centered about the changes in the anterior portion of the globe. One of the things that interested Dr. Fry was the fact that they rarely observed a cup in the disc in these cases, because the tissues of the globes were so soft that it seemed to him it did not take a great increase in the tension to make the whole eyeball stretch as they saw it, and, therefore, in all probability it would not be until a very much later period of development that they

would find the real cupping of the disc.

He did not know whether anyone had been able to follow a case and make this observation. He never had because these patients drift away. It is almost impossible to keep one under observation for any length of time. But it seemed to him that the cupping of the disc in these cases would not occur until late, and would probably be much more rarely found than in adult glaucomatous cases.

Dr. H. G. Scheie mentioned a case of congenital glaucoma or hydrophthalmia in a patient on whom Dr. Adler had helped him operate earlier in the year. He thought this case was apropos for several reasons: In the first place, the child, a boy, had an elder sister, six years of age, at the Overbrook School, who was now blind from the disease. Dr. Scheie first saw the child when he was between six and seven months of age, at which time the intraocular pressure ranged between 40 and 50 mm. Hg in each eye. At that time the diagnosis was not difficult because the corneas were very large, and as soon as the eye was touched it was immediately realized that the globe was hard. The child was admitted, heavily sedated, and in the hospital the pressure was taken. Having read Anderson's book and noted the advice as to the type of operation of choice, particularly when performed before the infant was one year of age, Dr. Scheie decided on a bilateral trephining.

The child had now been followed for nearly seven months. Since operation the pressure in each eye had never been more than 29 mm. Hg, and had varied from 22 to 29 mm. Hg (Schiötz). By way of confirming Dr. Langdon's opinion, it was very interesting to observe that the nerve heads were normal even though the cornea showed typical changes.

The last time the child was examined, while under an anesthetic, Dr. Scheie be-

lieved he and Dr. Adler looked at him, and he was sure that the disc could then have been regarded as normal in each eye, even in the eye that had been running a slightly higher pressure.

Dr. I. S. Tassman thought that Dr. Langdon might be correct in his observation of this boy. The interesting point about that case was that the intraocular pressure when he was first seen at the age of five months was within normal limits, and there was no cupping of the disc at that time. The anterior portion of the eye, however, had been the same as it was now. Then, at the age of four years, the patient developed an increased pressure, and at the present time the cup was pathologic and the disc atrophic.

In the average case of hydrophthalmos it is difficult to make a fundus examination because of the haze of the cornea and the opacification that is often present; and the children are so young that it is almost impossible to make the observation. He did not obtain a satisfactory ophthalmoscopic examination in either one of the other two cases.

#### WHITE RINGS IN THE CORNEA (COATS)

DR. J. WALDMAN presented a paper on this subject which has been published in this Journal (November, 1942).

*Discussion.* Dr. W. Mengel stated that the incidence of this condition is probably greater than would be expected, due to the fact that many ophthalmologists do not routinely examine the cornea with the slitlamp.

This is a relatively clear-cut condition and should be easily differentiated. Superficial punctate keratitis is very definitely a different disease, as were nodular types of dystrophies of the cornea. However, there is a remote similarity between this condition and that of the ring-shaped type of familial dystrophy. Here again there should not be much difficulty in making the distinction because of the fact that

in ring-shaped familial dystrophy the ring-shaped opacities were situated in the superficial portion of the substantia propria, consisting of hyaline infiltration. The ring-shaped opacities in familial dystrophy were numerous, usually bilateral and progressive. One of the cases reported was observed over a period of five years, and manifested no particular change. The lesion in this condition is a great deal smaller, being only 0.5 to 1 mm. in diameter, whereas in the ring-shaped type of dystrophy the white rings were larger in most instances, so that there should not be any difficulty in differential diagnosis.

It was interesting to speculate as to the etiology of the condition. In a majority of the cases, the lesions are located in the lower portion of the cornea. This would raise the suspicion of a possible traumatic etiology. In the lower half of the cornea, the penetration of minute foreign bodies through the epithelium might stimulate Bowman's membrane and give rise to fatty infiltration in superficial portions of Bowman's membrane. In three of the cases presented, the rings were situated 3 or 4 mm. from the limbus. This suggested the possibility that inflammation or toxin might be a factor in producing these rings.

Dr. Mengel wished to ask Dr. Waldman where the rings were located in the fifth case. In three of the cases they were near the limbus. In the first they were located in the center of the cornea, which was a typical location for dystrophy. He would also like to ask whether or not other members of the family were examined for white rings in the cornea to detect a possible familial trait.

Dr. Alfred Cowan mentioned that he had seen quite a few of these cases. He thought they were fairly common, and he considered that they were the result of some slight trauma or foreign body in the cornea. They knew for a fact that

small foreign bodies in the cornea almost always left a ring opacity if they did leave an opacity.

The fact that these lesions existed in Bowman's zone did not mean that the epithelium was not damaged at the time of the injury. It did not mean that the condition started and ended in Bowman's zone. After an abrasion or a penetration of the epithelium the epithelium nearly always heals over the resultant scar, so that very likely these were scars or fatty degenerations of scars, which often take place. Dr. Cowan believed that nearly all of these conditions were foreign-body scars.

Dr. J. Waldman asked Dr. Cowan if he had seen these white rings associated intimately with a definite corneal macula or nebula.

Dr. Cowan replied that he had not seen them on top, but he had seen them as part of the macula, and he mentioned the case of a man he had seen two weeks previously, who had had a blast of a gas furnace in his face. His corneas were just covered with dust particles. In three or four days they could already see the formation of tiny ringlike opacities.

Dr. J. Waldman, answering Dr. Mengel, said the corneal change in the fifth case was in the upper outer quadrant, approximately at the 1-o'clock position, about 3 mm. from the limbus. He did not examine any of the families of any of the patients.

He might add, in answer to Dr. Cowan, that he had never seen one of these rings associated with any definite corneal macula or nebula. One case had been reported by MacRae in which it was stated definitely that a nebula was present.

#### FÖRSTER'S SYPHILITIC CHOROIDITIS

DR. G. P. MEYER and DR. J. V. KLAUDER reported a case from the Wills Hospital of acquired syphilitic chorioretinitis. The symptoms and signs of this condition

were briefly presented, and it was pointed out, as Förster did in 1874, that the clinical picture is pathognomonic of syphilis. It is relatively infrequent and the fundus findings are occasionally confused with neuroretinitis, choroiditis of nonspecific origin, and retinitis pigmentosa.

The most important diagnostic features were the characteristic field changes that were most often of a ring-scotoma conformation. Mistaken diagnoses followed the assumption that the mere presence of syphilis indicates that all ocular lesions are luetic.

An adequate early study of choroiditis is needed, so that an early etiologic diagnosis of syphilis might be made in the presence of this pathognomonic clinical picture.

Dr. J. V. Klauder commented that the choroiditis which bears Förster's name is, he thought, of interest from three aspects: first, the historic; second, the classification of lesions of syphilis of the eye; and, third, in clinical diagnosis.

From the historic standpoint it is interesting to note that Förster was professor of ophthalmology in the University of Breslau at the time Neisser discovered the *Gonococcus*. It is interesting, too, to correlate Förster's work on ocular syphilis with that period, the last 50 years of the 19th century, during which time the clinical investigation of syphilis reached its highest attainment. This was in the time of Fournier and Hutchinson. In the first 25 years of the 20th century, the peak in the laboratory investigation of syphilis was reached.

He could not obtain a comprehensive concept of Förster's choroiditis from any textbook in English. Some such texts discussed it in as little as 10 lines, which was, at least to him, unsatisfactory. Only from reading Förster's original paper (*Arch. f. Ophth.*, 1874, v. 20, pp. 33-82) and also the one by Rönne (*Acta Ophth.*,



1934-5, v. 12-13, pp. 1-37) did he obtain a proper concept of the disease.

Förster's work comprised one of the most interesting papers on the earlier clinical investigations of syphilis that he had read. He observed some patients for 15 years before he published his paper, which recorded a minute clinical description of the ocular lesions. He was firm in his conviction that the disease was diagnostic of syphilis, and maintained this opinion despite denial of infection on the part of the patient. He presented case records in which he made a diagnosis of early syphilis from ocular involvement. Such diagnosis was confirmed by other symptoms or by subsequent observation. One infers from Förster's paper that in the early stage of the disease the ring scotoma is the feature that is of diagnostic import.

Förster pointed out that, usually, the choroiditis first appears in the late secondary stage of syphilis, and enumerated other symptoms of this stage of syphilis that might be found upon examination of the patient.

The onset of choroiditis in the early stage of syphilis is consistent with the present-day concept that other syphilitic processes are initiated in this stage. After a period of dormancy, clinical symptoms appear. Particular reference was made to neurosyphilis and to aortitis. It was believed that clinical evidence of neurosyphilis recurs years after the invasion of the nervous system in the secondary stage of syphilis. Early in the course of neurosyphilis, the only evidence is a positive spinal fluid. The onset of peripheral choroiditis that characterizes congenital syphilis in infancy corresponds to the secondary stage of acquired syphilis. Uveitis of acquired syphilis is much more likely to recur in the late secondary stage of syphilis than years later.

Förster's choroiditis connoted to him a

disease process invariably appearing early in syphilis, its clinical picture varying somewhat, depending upon what period in the course of the disease is represented when the patient is first examined. The most diagnostic feature is a characteristic defect in the visual field. In any case, if a diagnosis of choroiditis or acquired syphilis is made, it is pertinent to ask what is the relation of this diagnosis to Förster's choroiditis, and what period in the evolution of Förster's choroiditis is represented. It appeared to Dr. Klauder that this attitude is more desirable than a diagnosis of acute or chronic disseminated choroiditis based chiefly upon a positive Wassermann reaction.

In diagnosis of syphilitic ocular lesions, he does not believe one could disregard the stage of the systemic infection. Such diagnosis should not be made solely on the basis of a positive Wassermann reaction. Diagnosis of a syphilitic process should correlate the stage of the systemic infection, the serologic evidence, and the response to antisyphilitic treatment. Another criterion applicable chiefly to uveitis or acquired syphilis is the Herxheimer reaction. This reaction is a "flare-up" of the uveitis, as observed by the slitlamp before and after the initial arsenical injection.

It is interesting to note that Rönne stated the opinion that there is only one type of choroiditis caused by syphilis, namely, the disease Förster described, with the exception of the rare form of central choroiditis and peripheral choroiditis of congenital syphilis.

Förster's choroiditis should be considered in the diagnosis of disseminated choroiditis, of neuroretinitis believed to be caused by syphilis, and possibly, too, in the diagnosis of retinitis pigmentosa. A form field to demonstrate a ring or ringlike scotoma is indicated in the



proper study of disseminated choroiditis thought to be caused by syphilis.

#### OCULAR LESION OF PYODERMATITIS VEGETANS (HALLOPEAU, DERMATITIS VEGETANS)

DR. J. V. KLAUDER reported the case of a white man, aged 28 years. The disease first appeared in 1937, and was confined to the mucous surface of the lower lip. It was presented as an erosion, the surface of which was studded with yellowish puncta resembling minute pustules. These punctate lesions could be removed by rubbing with gauze, in which event bleeding would result. Later, similar lesions appeared on the floor of the mouth, the gums, the buccal mucosa, the nares, and on the septa. At times, the process would considerably improve or disappear for a short period; later, there would be relapses of variable intensity.

In 1940 the process became pronounced, at which time papillomatous elevated lesions appeared on the lip and around the nares. These lesions resembled the illustration in Goldsmith's report (*Pyodermatitis vegetans*. *Brit. Jour. Derm.*, 1941). The papillomatous lesions disappeared following the administration of sulfathiazole.

In 1941 the upper lid became affected. The patient was seen by Dr. Alfred Cowan, who reported as follows: "The upper lid of the right eye was swollen, the margin being mostly involved. The edge of the lid behind the cilia was eroded and under the slitlamp presented a number of elevations containing puslike matter. Several of the hair follicles in this region were involved. There was increase in the number of small blood vessels and considerable hemorrhagic exudate. The epidermis was absent over the area and at the edge where it seemed to terminate there was much desquamation. The pustules were not deep, involving only the

superficial surface of the affected area. The surface was gently curetted and tincture of iodine applied."

The involvement of the eyelid disappeared in about three months and had not returned.

Histologic examination of the papillomatous lesion on the lip was not helpful in diagnosis. Examination showed only inflammatory reaction. General physical and laboratory examinations were essentially negative—an exception was the presence of *Staphylococcus aureus* in smears made at different times.

A variety of treatment was employed. The following therapy appeared to be effective in causing disappearance of the lesions, but not in preventing relapse: Sulfathiazole administered internally and also applied as an ointment; Fowler's solution internally, and the local application of iodine crystals in creosote.

At the present time the patient presented only localized involvement of the upper gums and just inside the nares.

*Pyodermatitis vegetans* is a benign inflammatory dermatosis, characterized by the occurrence of bullae or vesicopustular lesions forming exuberant granulations resulting in fungating, vegetating, condylomatouslike lesions. The disease favors the region of the orifices of the body. There are numerous relapses; periods of remissions may be of long duration. The predominating organism present is the *Staphylococcus aureus*. At least in the cases reported by Goldsmith and Walhouser (*Arch. Derm. and Syph.*, 1929, v. 19, p. 77) the disease at its onset is confined to mucous surfaces prior to the appearance of cutaneous lesions.

Dr. Klauder commented that, to his knowledge, conjunctival involvement in *pyodermatitis vegetans* had not been reported. He believed, however, that this diagnosis is justified despite the absence of cutaneous lesions, in view of the fol-

lowing features: The vegetating, papillomatous lesions on the lip and around the nares; the presence of pustules which were always the conspicuous lesion; the remissions and relapses; and the presence of *Staphylococcus aureus*. These features were characteristic of pyodermatitis vegetans.

This case illustrates the importance of examining all mucous surfaces in proper study and in diagnosis of conjunctival lesions. Some diseases of the conjunctiva represent one phase of pathologic processes that favor mucous surfaces. Mention might be made of ocular pemphigus and of erythema multiforme.

Warren S. Reese,  
*Secretary.*

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## LOS ANGELES SOCIETY OF OPHTHALMOLOGY AND OTOLARYNGOLOGY

April 27, 1942

Dr. JOHN OSBURN, *presiding*

### RETROBULBAR NEURITIS

Dr. HAROLD F. WHALMAN stated that a voluminous literature challenges the comprehension of the cause and diagnosis of retrobulbar neuritis; that in the evaluation of this material it is evident that a broader viewpoint must be adopted for the full understanding of the condition. He pointed out that the old conception of retrobulbar neuritis as a disease affecting only that small portion of the optic nerve between the eyeball and the chiasm is the reason for misinterpretation of bizarre manifestations of the disease; that the entire optic pathway from the eyeball to the primary optic centers should be considered rather than the former limited region. With this viewpoint in mind peripheral scotomata and bizarre field defects can be explained.

Dr. Whalman stated that almost any toxic agent can produce the syndrome of retrobulbar neuritis. With respect to sinus disease he pointed out that there is much controversy in the literature. It was his opinion that in the practice of the average ophthalmologist the percentage of cases caused by multiple sclerosis would be small but that in the larger clinics where chronic cases would eventually terminate, a high percentage of multiple sclerosis would be found.

The keynote of all treatment for acute retrobulbar neuritis is vasodilatation which can be brought about in many different ways; for example, by means of foreign-protein therapy, intravenous sodium nitrite, pilocarpine sweats, acetylcholine intramuscularly injected, intravenous iodine, lumbar puncture, and even sinus surgery which results in foreign-protein absorption and consequent vasodilatation. Dr. Whalman believed that vitamin-B complex should be administered in all cases of retrobulbar neuritis. It was his opinion that tuberculin and antiluetic treatment should be used when specifically indicated.

Lastly, he pointed out that retrobulbar neuritis should be thought of as a localized tissue anoxia from angiospasm followed by increased permeability of the vessels and sometimes thrombosis, similar to that of shock and histamine poisoning. He stated that the term *acute angiospastic neuropathy*, as suggested by Duggan, seems to be the most appropriate term for the syndrome rather than retrobulbar neuritis.

*Discussion.* Dr. Dennis Smith stated that he felt the broader conception of the location of the neuritic lesion was the most important step to a better understanding of the bizarre fields that one sometimes finds in this condition.

Dr. Kenneth Brandenburg emphasized the importance of the use of the whole

vitamin-B complex in order to maintain the proper balance of the vitamin elements and thereby achieve surer therapeutic effect.

Dr. Carl Fisher stated that there seems to be some tendency on the part of physicians to prescribe vitamin-B complex in cases of alcoholic retrobulbar neuritis without imposing sufficient restraint in the use of the etiologic factor; namely, alcohol.

#### EYE PHYSIOLOGY IN RELATION TO INDUSTRIAL AND MILITARY MEDICINE

DR. CLARENCE H. ALBAUGH said there appeared to be a considerable lag between the production of research data and its use by industry and the military. Whenever feasible, some coördinating body should be set up to expedite the use of knowledge gained by research. He said that the National Research Council fulfilled this function to some extent, but it was manifestly impossible for this body to consider the tremendous volume in the detail deserved.

Knowledge concerning color and color vision deserves more attention and that full color vision is a recent phylogenetic development. It had been observed that primitive peoples are most conscious of red and yellow, both of which have played a prominent part in their religion and warfare, as well as in domestic designs. The modern man, in the normal state, is a trichromat, although not a few have only dichromatic vision. The group that lies between these two, the anomalous trichromatic, however, may under certain conditions be either trichromatic or dichromatic. Under conditions of fatigue, oxygen deficiency, and nervous excite-

ment perception of red or green, or both, may be abnormal. Such conditions arise frequently in both industry and military operations. Lives may be endangered or equipment may be lost when individuals with such abnormalities are employed in key positions.

Dr. Albaugh stated that secret-communications problems have revived the use of colored lights. Small, intense beams of light that could be intercepted with extreme difficulty could be modified by use of selective filters which make code almost impossible of interpretation.

Draftsmen in the airplane industry complained of glare from the velum paper they work with. Although proper lighting conditions could correct this situation to a great extent, a certain amount of ceiling glare remains. If the intensity of light is sufficiently high, polaroid glasses are of definite value.

He said fluorescent lighting causes complaint from some workmen working with high-speed machines. Confusion arises from the stroboscopic effect as a result of the flicker of such lights. This situation can be corrected by use of tubes having noncorresponding frequencies of flicker, or two tubes out of phase with each other.

More attention should be paid to the relationship between fatigue and physiologic principles. It is well known that frequent short rest periods keep efficiency higher than long rests after periods of concentrated work. This should be kept in mind not only for extraocular-muscle efficiency, but also for accommodation.

Harold F. Whalman,  
Editor.

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*Author's proofs* should be corrected and returned within forty-eight hours to the *Manuscript Editor, Miss Emma S. Buss, 5428 Delmar Boulevard, Saint Louis 12, Missouri.* Twenty-five reprints of each article will be supplied to the author without charge. Additional reprints may be obtained from the printer, the George Banta Publishing Company, 450-548 Ahnaip Street, Menasha, Wisconsin, if ordered at the time proofs are returned. But reprints to contain colored plates must be ordered when the article is accepted.

## THE ACADEMY MEETING OF 1943

The forty-eighth annual meeting of the American Academy of Ophthalmology and Otolaryngology was called with considerable hesitation on the part of the Council, because of the war situation. The attendance, however, was extremely good. The unofficial figure, which the writer had neither the opportunity nor the inclination to confirm because it was such an interesting one that he did not want to have the delusion shattered, was 1,943, one attendant for each year of the Christian era.

The meeting place was, as usual now, the Palmer House, Chicago. This hotel lends itself best of any to our gathering. All hotels in cities big and little are

crowded these days and the Palmer House proved no exception, but considering the enormous demand for rooms and service with the appalling turn-over, the food and service were surprisingly good. Registration at the hotel was the chief difficulty. Undoubtedly another year will see some method evolved to avoid the serious inconveniences of this year.

The meeting was one of the best ever held. The shortened session does crowd events a bit, so it may be wiser to add another day to the next meeting to ease up somewhat on the condensation, though it is difficult for the doctor to take many days away from the office during this hectic time.

The presidential address and those of

the guests of honor and invited speakers were of a high caliber, and the symposium too was excellent. It is not easy to construct a program that will appeal to all of the different elements that gather on the first day of the convention, but this was very well done. The historical note that was introduced accomplished this nicely. Of general interest also was the Guadalcanal talk and, perhaps even more so, was the same speaker's later talk on the effect of high explosives diagrammatically and dramatically illustrated.

The orthoptic technicians were out in force for their evening program. Their place in the ophthalmologists' set-up becomes more certain and more important each year. The value of their time-consuming training for aiding vision and helping correct muscular imbalances constantly gains increasing recognition. It would have been nice if Dr. Lancaster's paper on "eye exercises for improving vision," in which they were vitally interested and which proved to be a masterly address, had been on the Monday, instead of on the Wednesday, program, since, as it turned out, very few of them were able to remain in the city for it. The writer, as a discussor of this paper in which the technicians had shown a marked preliminary interest, was particularly sorry because he had hoped that they would participate in the discussion of a subject about which they and all ophthalmologists are at present much concerned.

The instruction courses were the high lights of the convention as always. For the first time the writer, to his great regret, was unable to attend any of them, for in previous years he has invariably found them of tremendous value; so cannot report personally on them. But the accounts of them were as glowing as always.

Alumni dinners were 20 in number. They have become an increasingly popular feature of the meetings. Distinctly in

lighter vein and for the most part blessedly devoid of speeches, but full of song and that delightful accompaniment of song that keeps melody flowing, they furnish an excellent intermission in the midst of more serious matters. The only important contraindication to these dinners is that they detract from the attendance at the general evening of entertainment.

An excellent orchestra was a real addition to the Inter-Allied dinner as was also the chorus from the Great Lakes Naval Training Station. They sang beautifully. The less expensive dinner, which was excellent, was in keeping with war time. The official programs though simple were effective. The speeches were good and not too long. After listening to talks all day, one is grateful for brevity.

The week of October 8th was selected for the forty-ninth meeting and the Palmer House for the place. Dr. Gordon B. New, distinguished otolaryngologist of the Mayo Clinic was chosen President-elect.

Lawrence T. Post, M.D.

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### "HELLO DOC!"

The title "Doctor" as applied to the regular practitioner of medicine has an honorable lineage and many distinguished and dignified associations. But as a descriptive title it is by no means entirely satisfactory.

The graduate of a high-class and orthodox medical school is far from being the only person who may legally apply to himself the term "Doctor." He shares this distinction with dentists, with a large number of ministers of religion, and with educators who may be Doctors of Education, of Philosophy, of Science, of Laws, of Literature, or of Music. Last, but numerically by no means least in this heterodox age, the company includes Doctors of Osteopathy, of Chiropractic, and of Optometry. It becomes hard to maintain one's identity in such a multitude!

Walking along the city streets or in a place of public assembly, well-nigh every self-respecting practitioner of orthodox medicine has had the experience of hearing a cheery "Hello Doc," only to find, on instinctively turning his head in the direction of the speaker, that the person accosted belonged to a very different walk of life.

One of the delights meted out to the medical student while working in the college clinic, or even in social encounters with lay friends, is to be addressed by the title "Doctor," or more familiarly "Doc." Many a factory has among its workmen a "Doc" whose claim to the title arose from some quite insignificant contact with the medical art, such as working in a chemical laboratory, as an orderly in a hospital, as a drugstore clerk, or as an undertaker's assistant.

The word "Doctor," derived from the past participle of the Latin verb "docere" (to teach), had originally, and still very generally retains, a broad significance. In ordinary language the doctor is "a man skilled or learned in any profession; a teacher, professor, instructor." We are reminded of Luke's picture of the young Christ: "they found him in the temple, sitting in the midst of the doctors."

In the following passage Milton suggests merely the sense of skill:

"Of such doctrine never was there  
school

But the heart of the fool,

And no man therein doctor but him-  
self."

Dryden limited the use of the word to the physician in his scornful

"So lived our sires e'er doctors learned  
to kill

And multiplied with theirs the weekly  
bill."

In English universities where a Degree of Medicine is conferred it is commonly the M.B., or Bachelor of Medicine; the M.D. being an advanced degree. In the

United States the title M.D. for the graduate in medicine is always employed.

The term "doctor" has crept into many other usages, including an old name for brown sherry, and the familiar title for a donkey engine.

In gaming lore the use of the word "doctors" for false dice was humorously mentioned by the novelist Fielding: "Here are the little doctors, which cure the distempers of the purse"; and a like relationship is suggested by the old English slang expression, "to put the doctor upon one."

For good sociologic and scientific reasons, but also, we may as well admit, on economic grounds, the ophthalmologist has often been particularly incensed over the use of the title "Doctor" by opticians or optometrists. In some of our United States the laws on the practice of optometry forbid the assumption of this title by optometrists in such a way as to suggest that they are medical graduates.

It may be doubted, however, whether any court ever convicted or punished an optometrist for calling himself "Doctor" in such a way as to lead the public to suppose he was skilled in diseases of the eye. In at least one state where for a good many years such abuse of the title has been prohibited, officials of the State Board of Optometrists themselves use the title without any qualifying reference to optometry, and some optometrists display the title, without such qualification, on their professional stationery. Even though optometrists were to avoid such a custom, their clients or "patients" would continue it, for the general public makes no critical study of these matters and is very little concerned with the rights and wrongs of professional nomenclature.

The three university schools of optometry in the United States have refrained from conferring the degree of "Doctor" upon graduates in optometry. Independent schools of optometry have shown no such

scruples. Regular physicians, including ophthalmologists, commonly content themselves with the simple placing of the word "Doctor" before their names on envelopes, letterheads, prescription blanks, and accounts. Why, it might be asked, is such resort to the title "Doctor" any more objectionable on the part of graduate optometrists than on the part of Doctors of Medicine.

The situation is of course complicated by the fact that the title "Doctor" is also usurped by licensed optometrists who have never acquired a university degree. But the courts are not very likely to bother themselves about such looseness in the application of a term which is in the first place particularly vague and indeterminate. Incidentally, optometrists as a group are not altogether without justification for their claim that mere possession of the doctorate in medicine ought not to confer the right to pose as an expert in refraction.

In a number of states, there is no legal prohibition of the practice of ophthalmology by osteopaths, and those states which license the practice of "chiropractic" show no tendency to interfere with the measurement of refraction by chiropractors.

After all, the mere assumption of a title does not go so very far toward satisfying the discriminating public as to one's skill in the performance of certain functions in the care of the human body. Our better citizens are much more influenced by the experience of themselves and their neighbors as to the success or failure of the practitioner.

Some physicians have shown good judgment in substituting for the prefix "Doctor," on their professional stationery and in connection with their professional signatures, the title "M.D." As a matter of convenience, it may be well to consider whether this change ought not to become more general. The ethical principles of the orthodox American physician frown so

strongly upon anything that smacks of a striving after publicity as to professional qualification, that the eye physician is not likely often to describe and sign himself as "\_\_\_\_\_, M.D., ophthalmologist." Yet, as a matter of professional identity, this or a similar combination might possess some value for the general public as well as for the eye physician and surgeon.

W. H. Crisp.

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## BOOK NOTICE

RECONSTRUCTIVE SURGERY OF THE EYELIDS. By Wendell L. Hughes, M.D., F.A.C.S. Clothbound, 160 pages, 36 plates of 198 figures. St. Louis, C. V. Mosby Company, 1943. Price \$4.00.

This monograph may be divided into a brief historical section of about 30 pages and a section of 75 pages of description of various plastic surgical procedures, well illustrated with case reports, photographs, and diagrams.

The general principles for this type of work are clearly portrayed and the method of meeting individual problems well defined. For most ophthalmic surgeons plastic surgery about the eye is unusual. When confronted with a case, they want to turn to some reference book where they can study the handling of a similar case. They wish this given in minute detail. If the procedure does not seem too complicated for their experience, they will like to perform the operation, but want a comprehensive guide.

This book covers practically all of the lesions for which reconstruction is necessary, and it will therefore be a valuable addition to the library of anyone who is interested in this type of work.

There is an excellent list of 451 references from the text, and indices of authors' names and subjects. The illustrations are unusually good and the diagrams truly portray the method of procedure.

Lawrence T. Post.

# ABSTRACT DEPARTMENT

EDITED BY DR. WILLIAM H. CRISP

Abstracts are classified under the divisions listed below, which broadly correspond to those formerly used in the Ophthalmic Year Book. It must be remembered that any given paper may belong to several divisions of ophthalmology, although here it is mentioned only in one. Not all of the headings will necessarily be found in any one issue of the Journal.

## CLASSIFICATION

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| 1. General methods of diagnosis                        | 10. Retina and vitreous                                |
| 2. Therapeutics and operations                         | 11. Optic nerve and toxic amblyopias                   |
| 3. Physiologic optics, refraction, and color vision    | 12. Visual tracts and centers                          |
| 4. Ocular movements                                    | 13. Eyeball and orbit                                  |
| 5. Conjunctiva   | 14. Eyelids and lacrimal apparatus                     |
| 6. Cornea and sclera                                   | 15. Tumors   |
| 7. Uveal tract, sympathetic disease, and aqueous humor | 16. Injuries   |
| 8. Glaucoma and ocular tension                         | 17. Systemic diseases and parasites                    |
| 9. Crystalline lens                                    | 18. Hygiene, sociology, education, and history         |
|  | 19. Anatomy, embryology, and comparative ophthalmology |

### 1

#### GENERAL METHODS OF DIAGNOSIS

Athens, A. G. Visual malingering. *Minnesota Med.*, 1943, v. 26, March, p. 266.

Careful management is important in dealing with medicolegal cases. Various tests for exposure of malingering are discussed, such as fogging the vision of the good eye, Jackson's cross-cylinder test, numerous tests making use of prisms, the bar test, and Snellen's red-glass test.

Gertrude S. Hausmann.

Bruce, G. M. Simple methods for the detection of ocular malingering. *United States Naval Med. Bull.*, 1943, v. 41, May, p. 755.

The following are samples of the simple tests described by the author for detection of malingerers. While both eyes are open a 10-degree prism is held before the good eye so as to bisect the pupil. The patient will admit that he sees double, but if when the prism is pushed further he still sees double he sees with the allegedly bad

eye. After putting a pinhole disc before the good eye and having the patient read, the head is tilted backward or the disc is raised, when if the patient is then still able to read he reads with the bad eye. If the examiner has a red glass matching the color of a two-cent postage stamp, he places it before the good eye, and if the other eye is poor the patient will not see the stamp. Or the patient is induced to write with a red pencil. If the other eye is poor he will have difficulty in doing this.

R. Grunfeld.

Griffin, E. P., Gianturco, C., and Goldberg, S. Stereoscopic method for the localization of intraorbital foreign bodies. *Radiology*, 1943, v. 40, April, p. 371. (See Section 16, Injuries.)

Lebensohn, J. E. Visual rating, and presentation of an improved unlearnable letter chart. *United States Naval Med. Bull.*, 1943, v. 41, May, p. 744.

The author improved on the unlearnable Grow chart used by the Navy. This chart contains a series of lines of 20/20 letters and the candidate



has to approach the chart until he is able to read them. The author substituted serified letters for the Gothic type, believing the former to approximate best the Snellen standard of one-minute detail. He selected the ten most suitable letters, and each line vertically and horizontally has the same ten letters differently arranged. The author suggests that a definite time limit shall be required for the reading of a line. One-third second for a letter seems to be a fair measure. He further recommends that standards of permissible ametropia be established, since the trick of pinhole sighting may vitiate the findings in determination of emmetropic visual acuity. R. Grunfeld.

Lloyd, R. I. Retroillumination. *Amer. Jour. Ophth.*, 1943, v. 26, Aug., pp. 799-801. (2 illustrations, references.)

Pfeiffer, R. L. Roentgenography of exophthalmos with notes on the roentgen ray in ophthalmology. *Amer. Jour. Ophth.*, 1943, v. 26, July, pp. 724-741; Aug., pp. 816-833; and Sept., pp. 928-942. (37 illustrations, bibliography.)

## 2

### THERAPEUTICS AND OPERATIONS

Bellows, J. G. Local toxic effects of sulfanilamide and some of its derivatives. *Arch. of Ophth.*, 1943, v. 30, July, pp. 65-69.

Since topical application of the sulfonamide compounds is gaining widespread use in many branches of surgery, it is imperative that knowledge of the local tissue reaction to these drugs, which is meager and of controversial nature, be increased. In this experimental work the corneas of young adult rabbits were anesthetized

by means of a four-percent cocaine-hydrochloride solution, which was chosen not only for its anesthetic properties but for its drying effect on the epithelium. The drying effect was desired because it facilitated removal of the epithelium by rubbing of the cornea with dry gauze. Sulfanilamide, sulfathiazole, sulfapyridine, and sulfadiazine were used in the form of powder, a five-percent ointment, and a 20-percent suspension. The reactions were nearly alike with all drugs and forms of preparation. The average time for healing was 5 1/10 days in the control eye, and for the treated eyes 13 3/10 days. Furthermore, the sulfonamide compounds not only caused a delay in epithelization, but produced another unfavorable effect, namely scarring, which was found in all corneas. (4 illustrations, references.) Ralph W. Danielson.

Klein, M., and Sorsby, A. The sulfonamides in experimental ocular infections. *Brit. Jour. Ophth.*, 1943, v. 27, June, pp. 241-254.

The following facts concerning the tolerance of the eye to the various sulfonamides and as to their relative concentrations in the ocular tissues are reviewed from the literature. (1) Sulfanilamide is well tolerated by the eye when instilled into the conjunctival sac or introduced into the anterior chamber in saturated solution (0.8 percent). Sulfanilamide ointment 5 percent is also well tolerated when introduced into the conjunctival sac, and insufflation of sulfanilamide powder does not appear to be deleterious. (2) The various sulfonamides are not equally effective in penetrating from the blood stream into the eye. The aqueous-humor level of sulfanilamide and sulfapyridine is about two thirds

of the blood level, that of sulfadiazine is one half and that of sulfathiazole is one fifth. (3) On local administration of sulfanilamide solution, the levels of concentration in the aqueous are considerably lower than those obtained by oral administration and even these levels are not readily maintained owing to the great diffusibility of these drugs, but levels very much in excess of those reached by oral administration are obtained by insufflation of sulfanilamide powder into the conjunctival sac. Sulfanilamide ointment (5 percent) and sodium sulfacetamide also give a higher aqueous concentration than is obtainable by oral administration, while the level of corneal concentration is especially high. It is difficult to obtain high aqueous concentrations from local administration of sulfapyridine, sulfathiazole, or sulfadiazine.

It thus appears that higher aqueous levels and considerably higher corneal levels can be reached with various non-irritating local applications than by oral administration of the sulfonamides.

Experimental studies with rabbits to determine the efficacy of the sulfonamides in local treatment of ocular infections as compared with general administration of the sulfonamides are reported. Corneal infection with *B. pyocyaneus* and inoculation of streptococcus, pneumococcus, and staphylococcus into the anterior chamber were the methods of infection used. The results obtained were as follows. (1) General administration of sulfanilamide (in the form of sodium sulfacetamide) controls an intraocular inoculation of streptococcus hemolyticus and possibly also of pneumococcus, but does not control corneal inoculation with *B. pyocyaneus*. (2) Local application of sulfanilamide, sulfapyri-

dine, or sodium sulfacetamide appears to be largely ineffective against *B. pyocyaneus* infection of the cornea and there is no reason to believe that it is effective against streptococci inoculated into the anterior chamber. There is some suggestion that sulfanilamide ointment applied under a contact lens might favorably influence the course of a *B. pyocyaneus* infection of the cornea, but all other methods of local application appear ineffective.

The authors emphasize the vast clinical superiority of general administration of the sulfonamides over local application of these drugs. The value of local therapy is still an open question. (2 tables, references.)

Edna M. Reynolds.

Lillie, W. I. Treatment of herpes zoster ophthalmicus with smallpox vaccine. *New York State Jour. Med.*, 1943, v. 43, May 1, p. 857.

Eleven cases of herpes zoster ophthalmicus were treated with smallpox vaccine. All cases, regardless of the duration of the disease and the type of previous treatment, responded favorably. One case which had shown a severe local reaction to each smallpox vaccination had rapid ocular improvement, but developed meningo-encephalitis nine months later. It is questioned whether this meningo-encephalitis, which responded readily to treatment, was of virus origin.

Gertrude S. Hausmann.

McCulloch, J. C. Origin and pathogenicity of *Pseudomonas pyocyanea* in conjunctival sac. *Arch. of Ophth.*, 1943, v. 29, June, pp. 924-935. (See Section 5, Conjunctiva.)

Sagher, F., and Sagher, E. Absorption of infra-roentgen (Bucky) rays of various qualities by the anterior por-

tions of the eyeball. *Arch. of Ophth.*, 1943, v. 30, July, pp. 43-53.

The authors review the reports in the literature of treatment by infra-roentgen (also known as Grenz or border) rays. The writers were particularly interested in the problem whether the anterior portions of the eyeball might be exposed to high doses without damage to the anterior segment or to the deeper structures. Experiments were performed to determine the permeability of the anterior portion. Data obtained for rabbit cornea, sclera, and aqueous humor, and for human cornea and sclera, are given. These are compared with data for skin. Therapeutic possibilities are discussed, and attention is drawn to the relative innocuousness of even high doses of these rays. (References.)

Ralph W. Danielson.

Thygeson, Phillips. **Sulfonamide compounds in treatment of ocular infections.** *Arch. of Ophth.*, 1943, v. 29, June, pp. 1000-1022; also *Trans. Pacific Coast Oto-Ophth. Soc.*, 1942, 40th mtg.

Of the large number of sulfonamide compounds only azosulfamide, sulfanilamide, sulfapyridine, sulfathiazole, and sulfadiazine have come into general use in the treatment of ocular infections. Of these azosulfamide and sulfapyridine have largely been discarded. The concentration of every one of these drugs in the aqueous is less than the blood concentration. Paracentesis or intraocular inflammation increases the penetration into the intraocular fluids. Sulfadiazine seems to penetrate into the eye in higher concentration than does sulfathiazole.

Ocular infections may be treated by either oral or local administration of the drugs. The usual oral dose is sufficient to maintain a blood concentra-

tion of 5 to 10 mg. per 100 c.c. Locally the drugs may be applied in solution, powder, ointment, or emulsion. Penetration into the eye is increased by iontophoresis. In severe infections both oral and local administration may be employed.

There may be a number of toxic complications during the oral administration of the sulfonamides. Some patients are sensitive or develop a sensitivity to the drugs. According to Long, the only contraindication to the use of a sulfonamide drug is a previous toxic reaction to it. If any sign of toxicity results and if it is important to maintain treatment, another member of the group can be substituted. Renal calculi may form from precipitation of the acetylated drug when sulfathiazole, sulfapyridine, or sulfadiazine is employed. This condition may be avoided by keeping the urinary output at a minimum of 1,000 c.c. per day and by keeping the urine either neutral or alkaline in reaction. A patient taking one of the drugs should be seen daily and symptoms of toxicity noted. The scleras should be examined for jaundice and the conjunctiva for pallor as an evidence of anemia. Sore throat or skin rash may indicate a complication. The patient should be kept out of the sun lest cutaneous photosensitivity develop. Local allergic reactions may occur during the local administration.

There is reason to believe that some ocular infections could be treated by a combination of sulfonamide drugs and specific serums. Thus pneumococcic serum, staphylococcus antitoxin, meningococcus antitoxin or antiserum, gas-gangrene antitoxin, and streptococcus antitoxin might at times be profitably employed in this way. The bacteriostatic action of the drugs is enhanced by an increase in temperature. Hence

it might at times be desirable to combine fever therapy or foreign-protein therapy with the sulfonamides.

Most virus diseases do not respond well to the sulfonamides but there are some exceptions. There is some difference of opinion as to the effect of these drugs on trachoma. The author states that when properly administered, sulfanilamide is definitely curative in uncomplicated trachoma, and that only for trachoma complicated by severe secondary infection or by tear deficiency, trichiasis, or one of a few other conditions, is supplementary treatment required. It is likely that sulfadiazine and sulfathiazole will prove superior to sulfanilamide in the treatment of trachoma.

Inclusion conjunctivitis responds well to the sulfonamides. Local therapy usually suffices, especially in infants, so that oral administration is seldom necessary. Infection of the eye with lymphogranuloma-venereum virus responds to the sulfonamides.

Ocular gonorrhea yields in a spectacular manner to oral administration of the drugs. In general, the response of the ocular infection is much better than that of the urethral disease. Local treatment with the drugs has been reported as successful, but the seriousness of gonococcal infection more than justifies the slight risks entailed in oral administration. At present sulfathiazole appears to be the drug of choice but it is possible that sulfadiazine will replace it.

Infections with the beta-hemolytic streptococcus include erysipelas and impetigo of the lids, acute and chronic dacryocystitis, conjunctivitis, corneal ulcers, and panophthalmitis. Most of these infections have responded readily to sulfonamide compounds.

Staphylococcal infections of the eye

are probably the most frequent as well as the most important of all ocular infections. Unfortunately, the organism is relatively resistant to the drugs. Sulfathiazole is the most effective of the group and requires a rather high blood concentration. Local application of sulfathiazole is of value in staphylococcal conjunctivitis and blepharitis.

Pneumococcal infections are rather resistant to the sulfonamides. In pneumococcal ulcers of the cornea local therapy with powdered drug plus oral administration is indicated. Perhaps in fulminating ulcers the use of sulfathiazole or sulfadiazine with iontophoresis might prove of great value. Pneumococcal conjunctivitis gets well after simple therapy but sulfathiazole ointment is believed to shorten its course.

Infections with *B. pyocyaneus* are very serious and sometimes fail to respond to the sulfonamides. It is suggested that sulfathiazole or sulfadiazine be given orally in large doses combined with application of the powder to the conjunctival sac. Iontophoresis should be used when possible. The influenza bacillus and the diplobacillus of Morax-Axenfeld produce infections which yield to these drugs. Rarer sources of ocular infection, the meningococcus, colon bacilli, bacteria of the *Proteus* group and Friedländer's bacillus all respond more or less satisfactorily to the sulfonamides. *Clostridium welchii*, chancroid, actinomycosis, and streptothrix infections yield to the drugs.

Chemotherapy apparently is of no value in uveitis, either nonspecific or that due to sympathetic ophthalmia. The sulfonamides have no apparent value in brucellosis, tularemia, pemphigus, syphilis, or Mooren's ulcer. (Extensive bibliography.)

John C. Long.

## 3

PHYSIOLOGIC OPTICS, REFRACTION,  
AND COLOR VISION

Craig, F. N., and Beecher, H. K. Effect of carbon-dioxide tension on tissue metabolism (retina). *Jour. Gen. Physiology*, 1943, v. 26, May 20, p. 473.

The metabolism of rat retina was found to be sensitive to the concentration of the carbon-dioxide-bicarbonate buffer system. Increasing the carbon dioxide from 1 percent to 5 percent at constant pH nearly doubled both respiration and glycolysis. Increasing the carbon dioxide from 5 to 20 percent at constant pH had no effect on glycolysis, but depressed the oxygen uptake from 31 to 19.

In a medium containing glucose and the 1-percent carbon-dioxide-bicarbonate buffer, the addition of succinate increased the oxygen uptake from 12 to 26 without affecting glycolysis. Succinate had no significant effect in a medium containing glucose and phosphate. R. Grunfeld.

Craig, F. N., and Beecher, H. K. Effect of low oxygen tension on tissue metabolism (retina). *Jour. Gen. Physiology*, 1943, v. 26, May 20, p. 467.

Twice as much lactic acid was produced by rat retina in a medium containing phosphate as in a medium containing a bicarbonate buffer. In a phosphate medium the rate of respiration was sensitive to oxygen tension, for it was 38 percent lower at 10 percent and 51 percent lower at 5 percent than at 100 percent oxygen. Respiration and glycolysis showed a reciprocal relationship to each other when the oxygen tension was varied.

In a bicarbonate medium there was no sign of change in respiration when

the oxygen tension was lowered from 95 percent to 5 percent, but glycolysis was increased nearly to anaërobic level. R. Grunfeld.

Elwyn, H., and Knighton, W. S. A case of congenital high myopia with fundus changes. *Amer. Jour. Ophth.*, 1943, v. 26, Sept., p. 969.

Field, H. B. A comparison of ocular imagery. *Arch. of Ophth.*, 1943, v. 29, June, pp. 981-988.

Two different instruments, the eikonometer and the comparator, were used on 25 subjects for the determination of aniseikonia. In only one instance was there a great disagreement between the findings with the two instruments. It was found that patients were more sensitive to small size-differences when using the eikonometer than with the comparator, but heterophoria both vertical and horizontal was found more frequently and was of greater amount with the comparator. There is a close relationship between heterophoria and aniseikonia and the comparator offers a possibility of segregating these two elements. It is concluded that size differences are more readily identified with the eikonometer, while the comparator makes use of what is essentially a mechanical parallax screen cover method of determining heterophorias. (One table.)

John C. Long.

Gallagher, J. R., Gallagher, C. D., and Sloane, A. E. A critical evaluation of pseudo-isochromatic plates and suggestions for testing color vision. *Yale Jour. Biol. and Med.*, 1942, v. 15, Oct., pp. 79-98.

At an eastern preparatory school, where color-vision tests are a part of the annual medical examination, the pseudo-isochromatic plates published

by the American Optical Company and made by the Beck Engraving Company were used in the testing of 726 male adolescents in 1941. The results were doubtful in so many cases that the authors decided to make a critical evaluation of these color plates and to attempt to devise such methods of using the plates as would produce more uniform and less confusing results. Having carried out their program on a group of 167 boys and 107 girls, the authors are able to offer two revised methods which have given better results with fewer plates. (Tables.)

Francis M. Crage.

Kekcheyev, K., Derzhavin, N., and Pilipchuk, S. Problem of night vision. *War Med.*, 1943, v. 3, Feb., p. 171.

Night vision is especially important in this war because of the greater part played by night battle and reconnaissance operations. Reference is made to previous work on the subject, particularly as tending to show that excitation of any one sense organ by a customary and adequate stimulus causes immediately a change in the sensitivity of other sense organs, either heightening or diminishing it. Weak excitations of some sense organs enhance the sensitivity of other sense organs, including those of sight, whereas strong excitations may have an opposite effect. Fullness of stomach, bladder, or bowel is said to diminish dark adaptation. By a new procedure the authors claim to have reduced from a half hour to five or six minutes the time necessary for dark adaptation.

Francis M. Crage.

Knapp, A. A. Practical points in refraction. *United States Naval Med. Bull.*, 1943, v. 41, May, p. 750.

The author gives a few practical

points in refraction. Among others, he states that a distance of 15, 10, or even 5 feet is sufficient for a visual test, provided the test letter subtends a five-minute visual angle. The author rejects the duochrome test for control of refraction. He found that by use of this test the patient would be given more plus and more minus than actually required.

R. Grunfeld.

Lancaster, W. B. A reply to certain criticisms of aniseikonia. *Amer. Jour. Ophth.*, 1943, v. 26, Sept., pp. 943-960; also *Trans. Amer. Ophth. Soc.*, 1942, v. 40, p. 77. (11 figures, 6 case reports.)

Leopoldsberger, W. Influence of external factors upon the fusion faculty. *Wiener klin. Woch.*, 1942, v. 55, Sept. 4, pp. 705-711.

A large group of soldiers with approximately emmetropic refraction were examined before and after three hours of field exercise. The examination procedure consisted in determining existing heterophorias, the field of gaze, that is, the limits of muscular power of each eye in the vertical and horizontal meridians, and the amplitude of fusion in these meridians. The field of gaze is widest below, and entirely independent of orbital ridge or nose, representing purely muscular power. A group of orthophoric and a group of esophoric persons were thus examined. It was found that physical exercise diminished the width of fusion, but the muscular power remained unaltered. Thus fatigue influences only the cerebral and not the muscular component of the fusion process. The decrease of width of fusion was independent of existing phorias.

Bertha A. Klein.

Lindeman, V. F. Comparative study of oxygen consumption of vertebrate

retina, with especial reference to the nucleoprotoplasmic ratio. *Amer. Jour. Physiology*, 1943, v. 139, May 1, p. 9.

Cytologic measurements and oxygen-consumption determinations were made upon the following vertebrate retinas: sucker, chub, shiner, frog, nocturus, toad, snake, tortoise, and alligator. The carefully separated retina was placed in a test tube containing 2 c.c. of 25-percent acetic acid in water. Gentle shaking reduced the tissue to a fine suspension of intact nuclei and dissolved cytoplasm. One-fourth c.c. of one-percent methyl green was added to stain the nuclei for 15 minutes. Samples were removed with a white-cell diluting pipette, a drop of the suspension was placed under the cover glass of a hemocytometer counting-chamber and the nuclei were counted. Furthermore, the volume of the nuclei was measured and the protoplasmic volume computed.

The cell population of the different retinas was found to range from 72,000 per mg. in nocturus to 925,000 per mg. in the shiner, with a good range of distribution between the extremes. No apparent correlation seemed to exist between the nucleoprotoplasmic ratio and the mean rate of oxygen consumption of the various retinas. This indicates that the whole protoplasmic mass contributes equally to the total metabolism of the cells.

The oxygen consumption of the individual nerve cells was computed in relation to their nuclear and cell volumes.

R. Grunfeld.

Luckiesh, M., and Moss, F. K. Initial and residual effects of ophthalmic prisms on visibility and accommodation. *Arch. of Ophth.*, 1943, v. 29, June, pp. 968-974.

A technique has recently been de-

vised for studying the accommodative changes accompanying vergence without the variable of relative accommodation which is introduced by optical stimuli. This technique does not inhibit the neural coupling between vergence and accommodation, hence it is unique for study of the effects of prismatic power on visibility and on accommodation. Tests made at 40 cm. indicate that the effects of prismatic power extend beyond simple changes in focus and conceivably induce an aniseikonic condition. Additional plus power is required for maximal visibility when the test object is viewed through base-in prisms. Similarly, additional minus power is required with base-out prisms. The data obtained are summarized graphically. (4 charts.)

John C. Long.

McKee, T. L. Restoration of binocular vision after unilateral cataract extraction. *Arch. of Ophth.*, 1943, v. 29, June, pp. 996-999.

It is generally considered that full correction cannot be worn after cataract extraction if the eye not operated upon has normal vision. There have been several cases reported in the literature in which this generalization was not true. The author reports such a case in a 37-year-old army officer. The patient complained of failing vision of the left eye of one month duration. No history of injury could be elicited. On examination an immature cataract was found and a small foreign body was seen embedded in the lens. No foreign body was visible on X-ray examination. The cataract was removed by linear extraction and the foreign body was extruded with the lens. The foreign body proved to be iron oxide. Following the surgery, the refraction was as follows: right eye,

+0.25 D. sph. +0.25 D. cyl. axis 145°, vision 6/5; left eye, +11.00 D. sph. +2.00 D. cyl. axis 165°, vision 6/5. The patient was so well pleased with the vision as determined with the trial frame that he insisted on having glasses made. A cement bifocal was provided for the aphakic eye. He has since worn the glasses with comfort, and when tested with the stereoscope was found to have depth perception. (References.)

John C. Long.

Martin, L. C. A standardized color-vision testing lantern. 2. Transport type. *Brit. Jour. Ophth.*, 1943, v. 27, June, pp. 255-259.

The addition of an orange-yellow filter with a wave length of 5970A to the original red-green and white filters in the standard color-vision testing-lantern is recommended because of the extensive use of orange signal lights in rail and road signals.

Edna M. Reynolds.

Ogle, K. N. Association between aniseikonia and anomalous binocular space perception. *Arch. of Ophth.*, 1943, v. 30, July, pp. 54-64.

Early in the research in aniseikonia, it was recognized that differences in the size and shape of the ocular images of the two eyes had an important effect on correct binocular stereoscopic spatial localization. The author has done further research and analysis along this line and reports that this phenomenon may not be apparent in ordinary surroundings, but that it becomes manifest as soon as the field of vision is restricted to an environment where there are few strong clues from perspective or known form. Ogle says that image-size differences can be detected and measured by means of instruments

that depend on binocular spatial localization. The data from this project throw light on the aniseikonia-anisophoria problem. (6 drawings, references.)

Ralph W. Danielson.

Riddell, W. J. B. A note on the spherical equivalent of spherocylindrical lenses. *Brit. Jour. Ophth.*, 1943, v. 27, July, p. 302.

The spherical equivalent of any formula for the correction of astigmatism has been defined by Prangen as being equal to the value of the spherical lens plus half the value of the cylinder added algebraically. If the cylinder is reduced by any given amount, half of this should be added to the existing sphere. This method is recommended by the author particularly in the refraction of school children and aphakic patients. The procedure is useful in patients with a mixed astigmatism in whom it may be desirable to undercorrect the astigmatic portion of the error. Three tables are given, listing the spherical equivalents of various combinations.

Edna M. Reynolds.

Shoemaker, R. E. The pseudoisochromatic plate test of color vision. *Arch. of Ophth.*, 1943, v. 29, June, pp. 909-918.

The Kries and Nagel classification of color defects is discussed along with various methods of color testing. By means of pseudoisochromatic plates, 803 men were tested for impaired color vision. Of these, 11.4 percent were found to have defective color vision. As classified according to the number of errors made it was found that 1.9 percent had slight defects, 1.6 percent had moderate defects, and 4.9 percent had severe defects. It was found, on the basis of relative color aptitude, and



from a practical viewpoint, that persons with slight impairment of color vision might be satisfactory for ordinary color work but should not be trusted under adverse conditions or for work requiring superior judgment of colors.

Tests were made with the pseudoisochromatic plates of Stilling, Ishihara, and Rabkin, and with those made by the American Optical Company. The Rabkin test (Russian edition of Ishihara) is of value in determining the type of color defect. It was found that it made little difference whether the tests were conducted in daylight, in ordinary electric light, or in electric light produced with daylight (blue) bulbs. The tests with pseudoisochromatic plates gave a relatively sensitive indication of the severity of impairment of color vision. The ease and rapidity of the test makes it valuable in routine work. (One table, references.)

John C. Long.

Sloane, A. E. Refraction clinic. *Amer. Jour. Ophth.*, 1943, v. 26, Aug., pp. 856-859.

## 6

### CORNEA AND SCLERA

Bach, E. C. Epidemic keratoconjunctivitis. *Wisconsin Med. Jour.*, 1943, v. 42, April, p. 415.

At present there are in the Milwaukee area over a thousand cases of keratoconjunctivitis. It is important to realize that the source of infection in many cases has been traced to first-aid rooms in plants and to the offices of physicians where the contagiousness of this disease was not realized. Epidemic keratoconjunctivitis is nonpurulent, and usually involves one eye only. It is characterized by edema, inflammation, swelling of the regional lymph

nodes, and subsequent appearance of punctate opacities in the cornea. The incubation period is from 5 to 12 days. The cause seems to be a virus. Mild treatment, including cold compresses and bland ointments, seems to give the best results. (References.)

Gertrude S. Hausmann.

McArevey, J. B. A case of fistula of the cornea. *Brit. Jour. Ophth.*, 1943, v. 27, July, p. 306. (See Section 16, Injuries.)

Smith, J. W. Ochronosis of the sclera and cornea complicating alkaptonuria. *Trans. Sec. on Ophth., Amer. Med. Assoc.*, 1942, 93rd mtg., p. 66. (See *Amer. Jour. Ophth.*, 1943, v. 26, July, p. 779.)

Tisdall, F. F., McCreary, J. F., and Pearce, H. The effect of riboflavin on corneal vascularization and symptoms of eye fatigue in R.C.A.F. personnel. *Canadian Med. Assoc. Jour.*, 1943, July, v. 49, p. 5.

Among healthy young adults in Canada vascularization of the cornea is surprisingly frequent. It seems to be related to paucity of riboflavin-containing foods in the diet. The subjective symptoms of vascularization of the cornea are fatigue, aching, and watering of the eyes, a sandy sensation under the lids, dizziness, headache, intolerance to reading, and decreased visual acuity. Administration of large doses of riboflavin (9.9 mg. daily) over a period of two months decreased the vascularization of the cornea in a large percentage of the cases. It also caused marked improvement in symptoms of eye fatigue in men exposed to glare in their flying duties. (9 illustrations.)

Gertrude S. Hausmann.

## 7

# UVEAL TRACT, SYMPATHETIC DISEASE, AND AQUEOUS HUMOR

Hess, Leo. Heterochromia of iris. *Arch. of Ophth.*, 1943, v. 30, July, pp. 93-104.

Many years ago Ernst Fuchs pointed out that heterochromia of the iris was of two types. The first is characterized merely by difference in the color of the irises, without any pathologic change either in the eyes or, apparently, elsewhere in the body (heterochromia simplex). The characteristic signs of the second type are, in addition to the difference in color, slight cloudiness of the lens and of the vitreous body and delicate precipitates on Descemet's membrane (heterochromia complicata). Even more interesting from the standpoint of general pathology is a third type of heterochromia, in which signs of involvement of neural elements are present (heterochromia sympathica). The present author divides this third group into two subtypes: one in which nothing but heterochromia and a sympathetic nerve lesion (Claude-Bernard-Horner syndrome) can be found, the eyes being otherwise normal; and the other in which, in addition to the preceding, there are other congenital abnormalities such as colobomata and ectopia of the pupil.

Heterochromia and many of the nervous-system signs can be accounted for by a congenital anomaly of the lowest part of the cervical portion of the spinal cord. Heterochromia is not a localized peculiarity of the iris, but is connected with abnormal development of the skull, the spinal cord, and the brain. It occurs much more frequently in persons with dark-blond or dark-brown hair.

The author reports 15 cases of heterochromia simplex, two cases of heterochromia complicata, and one of heterochromia sympathica. In the last group the involvement of the spinal cord is evidenced by localized muscular atrophy, reflex abnormalities, vasomotor changes, incontinence, distribution of fat, and scoliosis of the spine. In studying this type of case the author was impressed with the appearance of the skull, an associated abnormality not heretofore reported. The head is brachycephalic or mesocephalic. The forehead, in many cases bulging in its upper point, and with pronounced frontal bosses, shows a definite metopism. The metopism, which begins immediately above the glabella, is either located in the midline or deviates to the right or to the left, apparently according to a concomitant asymmetry of the skull. (References.)

Ralph W. Danielson.

Lloyd, R. I. Extrapapillary coloboma. *Trans. Amer. Ophth. Soc.*, 1942, v. 40, pp. 333-338.

A clear, concise description of this congenital lesion is presented, with a brief review of the literature. The characteristics of the defect are (1) sharp, clear outlines, (2) pigment anterior to the arteries, (3) lesions unaltered over a long period of time, (4) very white floor because there is no chorioidal debris to soften the view of the bare sclera, (5) veins not crossing the lesions unless they are close to the disc, although arteries frequently do cross, (6) absolute scotoma.

Theories of development of these defects are discussed with emphasis on the hereditary factor. The three conditions with which extrapapillary coloboma may be confused are: healed tuberculous chorioretinitis, a type of

hereditary macular degeneration with proliferation of pigment, and the results of extensive hemorrhage. (4 drawings, bibliography.)

David Harrington.

Rycroft, B. W. Choroidal detachment. *Brit. Jour. Ophth.*, 1943, v. 27, July, p. 283. (See Section 8, Glaucoma and ocular tension.)

## 8

### GLAUCOMA AND OCULAR TENSION

Rycroft, B. W. Choroidal detachment. *Brit. Jour. Ophth.*, 1943, v. 27, July, p. 283.

Theories regarding the cause of choroidal detachment are reviewed and a case of choroidal detachment of the immediate type (tear of the ciliary body with aqueous percolating into the suprachoroidal space) is presented. Experimental and clinical investigations into the cause and treatment of choroidal detachment in animals and men are reported. Increase in tension of cats' eyes to 40, 60, and 80 mm. Hg was produced by injection of saline into the vitreous chamber. A 2-mm. trephine opening at the limbus was made and the choroid was examined ophthalmoscopically at half-hour intervals for four hours and also on the following three days. No detachment of the choroid was produced in any animal. In man, the fundus of every case of trephining, cataract extraction, and iridectomy was examined within 48 hours of operation. Sixty eyes with cataract extraction, both intracapsular and extracapsular, eighty eyes which had been trephined, and six eyes subjected to iridectomy for the relief of subacute glaucoma were examined. Two choroidal detachments in the extracapsular group of cataract

cases, both of the immediate type and both subsiding without untoward result, were observed. Of the eighty trephine cases, 18 showed choroidal detachment. Of these 18, two resulted in delayed reformation of the anterior chamber and hypotony, one healed without filtration, and another showed capsular changes and subsequent lens opacity. This last case is the one reported in detail by the author. The anterior chamber did not reform for three weeks and hypotony persisted. No choroidal detachment was observed after broad iridectomy in four cases of acute glaucoma.

The following conclusions as to the etiology of choroidal detachment are presented: It is primarily due to a forward movement of the diaphragm constituted by the ciliary body, the suspensory ligament, and the lens. This probably results in a tear near the ora serrata. Sudden loss of the anterior chamber is the primary cause and not the result of a choroidal detachment. Individual technique in the trephine operation has no bearing. Detachment occurs in cases with either large or small trephine openings, with either complete or peripheral iridectomy, and irrespective of initial tension. It is more prone to occur in cases of chronic glaucoma where the deep anterior chamber allows greater forward movement of the iris-lens diaphragm. When the peripheral tear in the choroid heals, the aqueous passes into the anterior chamber. If the conjunctival flap is sealed, the anterior chamber reforms, the filtration bleb appears, and the fluid beneath the detached choroid is absorbed.

The most satisfactory form of treatment seems to include closure of the fistula in the conjunctival flap. In the case reported, a leak close to the tre-

phine hole was demonstrated and this was covered with a vistor conjunctival flap. Within ten days the choroidal detachments were healed. (4 illustrations).  
Edna M. Reynolds.

## 9

## CRYSTALLINE LENS

Dunlap, L. G. Safety in cataract extraction. *The Journal Lancet*, 1943, v. 58, June, p. 170.

The author describes the numerous prophylactic measures he is taking to safeguard his cataract operations. Since the average surgeon does not perform more than thirty cataract operations a year, each operation should be planned carefully. On the day previous to the operation the author visits the patient, preferably in the company of a relative, to answer questions and alleviate fears. The surgeon too, the author claims, should prepare himself several days in advance by refraining from coffee, alcohol, tobacco, loss of sleep, or mental worry.

The elder Fuchs made it a rule to operate all one-eyed cataract patients by the extracapsular method. The intracapsular method has other contraindications, such as high myopia, increased intraocular tension, and hypermature cataract. The safest procedure, the author suggests, is to adhere to the extracapsular method.  
R. Grunfeld.

## 10

## RETINA AND VITREOUS

Cordes, F. C. The use of vasodilators in acute fundus disease. *Amer. Jour. Ophth.*, 1943, v. 26, Sept., pp. 916-927. (References.)

Craig, F. N., and Beecher, H. K. Effect of carbon-dioxide tension on tissue metabolism (retina). *Jour. Gen.*

*Physiology*, 1943, v. 26, May 20, p. 473. (See Section 3, Physiologic optics, refraction, and color vision.)

Klinger, L. H., and Blanner, S. A. Amaurotic familial idiocy in identical twins. *Amer. Jour. Dis. Children*, 1942, v. 64, Sept., p. 492.

The twins showed the usual cardinal symptoms, paralysis, blindness, and dementia. The authors accept the usual statement that amaurotic idiocy is preeminently a disease of the Jewish race. Consanguinity is one of the most frequent causes. The fundus is normal for the first few weeks, but soon shows in the macular region a grayish-white area in the center of which is a cherry-red spot. The children die before their third year. There are two theories of pathogenesis. One contends that, as the result of some unexplained faulty lipid metabolism within the ganglion cell, prelipid lecithin-like products are deposited within the cell. The other theory views the disease as a manifestation of generalized disturbance in lipid metabolism throughout the entire body. Gertrude S. Hausmann.

Lindeman, V. F. Comparative study of oxygen consumption of vertebrate retina, with especial reference to the nucleoproteoplasmic ratio. *Amer. Jour. Physiology*, 1943, v. 139, May 1, p. 9. (See Section 3, Physiologic optics, refraction, and color vision.)

Lloyd, R. I. Extrapapillary coloboma. *Trans. Amer. Ophth. Soc.*, 1942, v. 40, pp. 333-338. (See Section 7, Uveal tract, sympathetic disease, and aqueous humor.)

Lubin, A. J., and Marburg, O. Juvenile amaurotic idiocy. *Arch. of Neurology and Psychiatry*, 1943, v. 49, April, p. 559.

A case of the juvenile type of amaurotic family idiocy is described. In spite of severe cellular changes, many cortical functions were retained, and the electro-encephalographic pattern was not especially impaired. (8 illustrations.)

Gertrude S. Hausmann.

Neame, Humphrey. A modification of Arruga's speculum. *Brit. Jour. Ophth.*, 1943, v. 27, July, p. 310.

An instrument made of plastic material, 2 mm. wider than the original Arruga speculum used in operations for detachment of the retina, is described and illustrated. The advantages are (1) that the instrument gives a larger field within the hollow of the retractor for the application of diathermy; (2) that the illumination is free from heat and obviates the presence of shadows; and (3) that the instrument is a nonconductor of electricity. Edna M. Reynolds.

O'Brien, C. S., and Allen, J. H. Ocular changes in young diabetic patients. *Trans. Sec. on Ophth., Amer. Med. Assoc.*, 1942, 93rd mtg., p. 59. (See *Amer. Jour. Ophth.*, 1942, v. 25, Nov., p. 1395.)

Philps, Seymour. Traumatic edema of the macula. *Brit. Jour. Ophth.*, 1943, v. 27, July, p. 305.

Four cases of commotio retinae are presented as demonstrating four stages in the progress of macular edema.

The first case showed gray swelling of the macular area which did not subside. The second case showed marked pigmentary changes in the macula. The third showed a punched-out hole in the macula. The fourth showed a macular hole with detachment of the retina. (4 illustrations.)

Edna M. Reynolds.

Rycroft, B. W. Choroidal detachment. *Brit. Jour. Ophth.*, 1943, v. 27, July, p. 283. (See Section 8, Glaucoma and ocular tension.)

Sirles, W. A., and Slaughter, H. Pigmentary degeneration of the retina and nerve type of deafness. *Amer. Jour. Ophth.*, 1943, v. 26, Sept., pp. 961-966. (7 audiograms, references.)

## 12

### VISUAL TRACTS AND CENTERS

Walsh, F. B. Certain abnormalities of ocular movements. *Bull. New York Acad. Med.*, 1943, v. 19, April, p. 253. (See Section 4, Ocular movements.)

## 13

### EYEBALL AND ORBIT

Penn, J., and Brown, L. The rapid preparation of eye sockets. *Surg., Gynec., and Obstet.*, 1943, v. 76, Feb., p. 204.

The authors describe a method which reduces the period of hospitalization and aftercare from a few months to a few days. Francis M. Crage.

Pfeiffer, R. L. Roentgenography of exophthalmos with notes on the roentgen ray in ophthalmology. *Amer. Jour. Ophth.*, 1943, v. 26, July, pp. 724-741; Aug., pp. 816-833; and Sept., pp. 928-942. (37 illustrations, bibliography.)

Stone, L. S., and Cole, C. H. Grafted eyes of young and old adult salamanders (*amblyostoma punctatum*), showing return of vision. *Yale Jour. Biol. and Med.*, 1943, v. 15, May, p. 735.

In 78 young and old adult salamanders the authors successfully reimplanted the right or left eye in the same animal. In 26 cases they transplanted the eye to a new host. The grafts were normally oriented and

showed a high capacity for recovery. The eyes appeared normal except for a reduction in size. Return of circulation in the iris was noted in the majority of cases as early as the second week. The pupillary reflex failed to respond to light for an interval of from 3 to 101 days, but when the hosts were kept alive long enough the reflex always returned. The lens did degenerate, but in some cases it became opaque temporarily and then cleared up again. Histologic examination revealed that in these cases the recovery was complete. Within three weeks after the operation the retina degenerated and from the cells at the ciliary margin a new retina regenerated which was thinner than normal and might show defects in the ganglion layer. A new optic nerve connected the eye with the brain through the optic chiasm. Vision was usually established after the second month. Ocular movements were noted after six weeks but were usually restricted because of imperfect ocular attachment.

R. Grunfeld.

#### 14

##### EYELIDS AND LACRIMAL APPARATUS

Cockburn, C. An operation for entropion of trachoma. *Brit. Jour. Ophth.*, 1943, v. 27, July, p. 308.

A modification of the Busacca operation for entropion is described. After excision of the tarsal plate, four to five sutures are inserted, passing through the skin of the inferior lip of the wound near the cilia and deep into the upper lip of the tarsus. The sutures are made taut and the ends are left long and are fixed to the eyebrow by adhesive plaster. The upper lip of the skin flap is undisturbed. It is not necessary to bandage both eyes. The sutures

are removed in four days. Sixty cases operated upon by this method have shown excellent cosmetic results and no recurrence of the entropion. (2 illustrations.)  
Edna M. Reynolds.

Naugle, T. C. Treatment of dacryocystitis in children. *Mississippi Doctor*, 1943, v. 20, Feb., p. 411.

The author treated four infants who had dacryocystitis. Two of them were treated by probing and by irrigation of the tear sac with boric-acid solution. The success was slight. The other two infants were treated by irrigation of the tear sac with 5-percent sodium-sulfathiazole solution, the result being prompt cure.  
R. Grunfeld.

Reese, A. B., and Wilber, I. E. The eye manifestations of xeroderma pigmentosum. *Amer. Jour. Ophth.*, 1943, v. 26, Sept., pp. 901-911.

#### 15

##### TUMORS

Fry, W. E., and De Long, P. Tumor formation at the disc. *Trans. Amer. Ophth. Soc.*, 1942, v. 40, pp. 325-331.

Different types of tumors which involve mainly the papilla are described briefly, and the literature of these tumors is very briefly reviewed. Some of the points in differential diagnosis are discussed.

The case is reported of an intra-ocular tumor observed briefly before enucleation of the eye. A pinkish-white tumefaction was observed abutting on the disc, resembling a retinal glioma but flattened in appearance. Retinal detachment developed later and still later a secondary glaucoma of the enucleated eye. There is presented a detailed pathologic examination with some photomicrographs. On the basis of the pathologic examination the au-

thors made a diagnosis of malignant melanoma involving the disc, with secondary glial hyperplasia. They feel that the structure was more nearly that of a scantily pigmented malignant melanoma than that of a neurofibroma and that the point of origin of the tumor was probably from choroidal elements at the lower inner margin of the disc, or misplaced choroidal elements within the disc itself.

Verhoeff, in discussion of the case, disagrees with the authors' diagnosis. He states that the tumor arose at the side of the papilla and was not a tumor of the papilla and was not a melanoma. He does not venture his own diagnosis. (References.) David Harrington.

## 16

### INJURIES

McArevey, J. B. A case of fistula of the cornea. *Brit. Jour. Ophth.*, 1943, v. 27, July, p. 306.

The fistula which was 1 mm. in diameter persisted five days after penetration of the cornea by a piece of metal, in a man aged 27 years. Because the tissue loss was so slight, the author felt that swelling of the corneal stroma might close the hole and allow healing to occur if the sides of the fistula were freshened up. A corneal opacity 2 mm. in diameter surrounded the fistula. With a discission needle, a series of perforations were made into the clear cornea just outside the opacity. These perforations were intended to enter the fistula at different levels. In addition, three small incisions were made into the corneal stroma with a Ziegler knife. A fine probe was passed into these openings and the corneal stroma was pushed toward the fistula. Both eyes were occluded with a light pressure bandage, which was removed in 48 hours. The anterior chamber had then

reformed. The injured eye was kept bandaged five days longer. Slitlamp examination showed a healed corneal wound, a normal anterior chamber, the eye free from inflammation, and no increase in the size of the original opacity. At the time of discharge from the hospital the patient's vision was 6/18.

Edna M. Reynolds.

Spaeth, E. B. The removal of metallic foreign bodies from the eyeball and from the orbit. *Trans. Sec. on Ophth., Amer. Med. Assoc.*, 1942, 93rd mtg., p. 36. (See *Amer. Jour. Ophth.*, 1943, v. 26, Jan., p. 110.)

Stieren, Edward. A metal safety and glare goggle. *Trans. Sec. on Ophth., Amer. Med. Assoc.*, 1942, 93rd mtg., p. 314. (See *Amer. Jour. Ophth.*, 1943, v. 25, Nov., p. 1402.)

## 17

### SYSTEMIC DISEASES AND PARASITES

Bellows, J. G., and Chinn, H. Intraocular hemorrhages in choline deficiency. *Arch. of Ophth.*, 1943, v. 30, July, pp. 105-109.

Report was recently made of changes in the eyes when weanling rats were placed on choline-poor diets. The authors have further investigated this phenomenon in rats. They found, in addition to other somatic changes, that many of the experimental rats showed a blood-specked nose, hemorrhage into the nail beds, and bloody tears. In each litter of six to ten animals, one or two showed some type of intraocular hemorrhage, usually within the 48 hours before death. The most common form was a column of blood in Cloquet's canal; next in frequency was a hemorrhage apparently arising in the region of the ciliary body and shortly spreading beyond the crystalline lens;

less commonly, hemorrhages visible to the naked eye appeared as hyphemia.

Sections stained with hematoxylin and eosin revealed a generalized engorgement of the vessels throughout the eyeball. Free blood was most frequently found between the crystalline lens and the anterior limiting membrane of the vitreous. The ciliary processes were swollen and frequently hemorrhagic. The presence of blood in the anterior chamber was not uncommon.

The presence of lecithin in so many articles of the normal diet makes it unlikely that a choline deficiency on a purely dietary basis exists in man. However, among the conditions of ophthalmologic interest in which a possible deficiency may arise are pernicious anemia and diabetes mellitus. In these diseases there is a marked tendency to fatty changes in the liver, and the demand for choline is probably greater than normal. (References, 4 illustrations.) Ralph W. Danielson.

Lillie, W. I. Treatment of herpes zoster ophthalmicus with smallpox vaccine. *New York State Jour. Med.*, 1943, v. 43, May 1, p. 857. (See Section 2, Therapeutics and operations.)

Mendonça de Barros, José. Biomicroscopic aspects of the ocular complications of leprosy. *Ophth. Ibero Amer.*, 1939, v. 1, no. 3, pp. 169-178.

The author, who is Oculist of the Padre Bento Sanatorium of the Prophylactic Leprosy Service of the State of São Paulo, Brazil, describes biomicroscopic aspects of the ocular complications of leprosy as observed by him in the examination of 1,200 patients, in the course of seven years. He mentions an anomaly which he noticed in the vessels at the limbus, which were occasionally surrounded by a fine in-

filtrative sheath. The corneal involvement included the following changes: on the epithelial surface, edema, bullae and vesicles, ulcers, protrusion, band-shaped keratitis, and keratitis secondary to lagophthalmos. Changes in the stroma related particularly to the nerves, as seen by focal illumination and also by retroillumination. The nerves were surrounded by a sort of sheath and displayed nodules, sometimes taking on the appearance of strings of beads. The appearance of blood vessels in the cornea was not an early but a late finding, excluding those cases of sclerokeratitis which constitute corneal leproma. On the endothelial surface were seen edema, punctate keratitis, opacities, anterior synechiae, and a bulging backward. (20 figures in color.) W. H. Crisp.

Pirie, A. The relation of riboflavin to the eye. *Brit. Jour. Ophth.*, 1943, v. 27, July, p. 291.

In this review article, the chemistry and physiology of riboflavin are discussed and its occurrence in the body is described. In secretions such as milk and urine, riboflavin occurs largely in the free state and is therefore easily dialyzable. In tissues, it is combined with adenylic acid to form nondialyzable flavoproteins. In general, the liver, kidney, and heart of most animal species are the tissues richest in riboflavin, but all tissues so far examined contain small amounts. It is present in the retina of some species of fish in larger amounts than have been found in any mammalian tissue. Free riboflavin has been demonstrated in the retina of some species of fish. It is possible that in fishes riboflavin acts as a photosensitizer by absorbing short-wave light and transmitting it as light of longer wave length. In mammalian retinas,



the total riboflavin present is in general about 1/100th of that found in fish. There is no evidence that riboflavin acts in mammalian retinas as a photosensitizer.

In the ox eye, riboflavin has been found combined with adenylic acid in the following amounts: Traces in vitreous, aqueous, and lens, and the corneal substantia propria; 2 to 3 gamma per gm. wet weight of tissue in corneal epithelium, conjunctiva, iris, ciliary body, and choroid; 3 to 4 gamma per gm. wet weight in retina; 4 to 6 gamma per gm. wet weight in Meibomian glands, lacrimal glands and Meibomian secretion.

The effect of deprivation of riboflavin on the eyes of experimental animals is reviewed. The author points out that we do not know how the riboflavin content of blood and tissues changes in riboflavin deficiency, so that it is not possible to tell whether the vascularization of the cornea which is one of the earliest changes occurring in riboflavin deficiency is produced by deficiency of riboflavin in the cornea itself or by deficiency of riboflavin in the blood. In other tissues, riboflavin has been shown to take part in normal oxidation processes and it is assumed that it fulfills the same function in the eye.

Edna M. Reynolds.

Puig Solanes, M. Ocular manifestations of avitaminosis-A and of ariboflavinosis. *La Prensa Med. Mexicana*, 1943, July 15, pp. 86-89.

The author describes avitaminosis-A as a systemic disorder in which participate the ectoderm and its derivatives, especially the eye. The eye is the organ which is most sensitive to lack of vitamin A. The alterations produced in the eye by avitaminosis are of two types: hemeralopia and corneo-con-

junctival lesions, including prexerosis, xerosis, and keratomalacia. The author summarizes the results of investigations by Pillat and Kruse, and further discusses accessory alimentary influences, including especially lack of calcium.

W. H. Crisp.

## 18

### HYGIENE, SOCIOLOGY, EDUCATION, AND HISTORY

Beach, S. J. The American Board of Ophthalmology learns about written examinations. *Amer. Jour. Ophth.*, 1943, v. 26, Sept., pp. 911-915; also *Trans. Amer. Ophth. Soc.*, 1943, v. 41.

Blake, E. M. Historical review of the teaching of ophthalmology at the School of Medicine, Yale University. *Yale Jour. Biol. and Med.*, 1943, v. 15, May, p. 755.

The medical school was established in 1810 and the first class was enrolled in 1813, but only in 1876 was the first lecturer in ophthalmology and otolaryngology appointed, in the person of William Henry Carmalt, who was made Professor of Ophthalmology in 1879. In 1881 his title was changed to "Professor of Principles and Practice of Surgery." It is not known to the author whether with the change of title he gave up the teaching of ophthalmology. The next clinical professor was Arthur N. Alling, 1902, emeritus in 1938. At present the medical school has two clinical professors, the author, appointed in 1923, and A. M. Yudkin, appointed in 1934. The teaching staff consists of 13 well-trained ophthalmologists and two house officers.

R. Grunfeld.

Delaney, J. H. Traumatic aphakia and the workmen's compensation act. *Pennsylvania Med. Jour.*, 1943, v. 46, April, p. 685.

The injustice of the present Pennsylvania compensation law concerning traumatic aphakia is pointed out. No compensation is given in such cases if the corrected vision of the aphakic eye is 20/20. The state does not take into consideration the facts that binocular vision cannot be obtained and that depth perception is lost.

Gertrude S. Hausmann.

Kuhn, H. S. Some visual problems in modern industry. *Illinois Med. Jour.*, 1942, v. 82, Oct., pp. 286-289.

Industry now demands an ophthalmologist who on entering a plant makes himself familiar with the different patterns of the work, judges spatial relationships, and sets up standards for selection and placement of employees. He must find lines of activity where workmen more or less affected by color blindness can work efficiently with proper regard for their safety and for the advantage of the plant. He has to study the nature of close work, must correct refractive conditions, and must know how to rehabilitate inefficient workers. He must also consider glare factors and note when general conditions cause eye fatigue. Among other conditions the Committee on Industrial Ophthalmology has agreed on acuity tests for appraising the visual skill of employees as applied to the specific visual demands of each plant. The Committee's survey includes also distance acuity with and without glasses, color discrimination, muscle balance for distance and near, stereopsis, and the determination of near points for the right and the left eye and for both eyes together. Melchior Lombardo.

Post, L. T. Lifelong care of the eyes. *Trans. Sec. on Ophth., Amer. Med. Assoc.*, 1942, 93rd mtg., pp. 17-23. (See *Amer. Jour. Ophth.*, 1942, v. 25, Oct., p. 1273.)

Rosen, George. New York City in the history of American ophthalmology. *New York State Jour. Med.*, 1943, v. 43, April 15, p. 754.

In 1820 the first permanent hospital for diseases of the eye, the present Eye and Ear Infirmary, was founded in New York City. This Infirmary was intimately connected with the development of the first ophthalmological society (American). The emergence of ophthalmology as a specialty was intimately linked with New York City. (References.)

Gertrude S. Hausmann.

Selling, L. S. The ophthalmologist's place in the prevention of traffic accidents. *Trans. Sec. on Ophth., Amer. Med. Assoc.*, 1942, 93rd mtg., p. 24. (See *Amer. Jour. Ophth.*, 1943, v. 26, Jan., p. 114.)

Solandt, D. Y., and Best, C. H. Night vision. *Canadian Med. Assoc. Jour.*, 1943, v. 49, July, p. 17.

With red lighting and red goggles it is possible to shorten the period necessary for dark adaptation. Red lighting of instrument panels may be employed to protect the night vision of personnel who are dark-adapted and on duty. Adaptometer tests should be used to select people with exceptionally good night vision for special training in night duties and to exclude night-blind individuals. Gertrude S. Hausmann.

Tarrant, A. J. M. Moorfields Eye Hospital in the "Blitz." *Brit. Jour. Ophth.*, 1943, v. 27, July, p. 312.

The Secretary of Moorfields Eye Hospital gives an account of the way in which the problems of the Blitz were met. The hospital is located in a vulnerable area. A temporary hospital outside London (at Edgeware) was taken over in October, 1939, and was con-

verted into a fifty-bed ophthalmic hospital complete with an operating theater. This country branch was able to deal with cataracts, detached retinas, glaucomas, and squints, leaving the eighty beds in the city hospital free to deal with accident and emergency cases. Some sense of security was given by providing an air raid shelter in the basement, with an air-conditioning apparatus and an auxiliary lighting plant. Patients, house-surgeons, nursing staff, cooks, engineers, maids, and porters all slept in shelters in the basement. Every evening as a matter of routine there was a steady, well-ordered removal to the shelter. Supper was served at six o'clock, after every one had "gone to earth" for the night. After the meal was cleaned away, any necessary dressings were done and the patients were made comfortable for the night.

Air-raid casualties with eye injuries were received from time to time. The greatest demand was made on the hospital on the night of the great fire in

the heart of London. No less than 128 firemen were seen as casualties. A temporary casualty department was set up in the air-raid shelter, but, as the number of injured firemen increased, it became necessary to return to the hospital's usual casualty department—a ground-floor room surrounded by glass. Surgeons and nurses worked continuously through the night. All the firemen were cared for within a few hours. None of them had to be admitted as an inpatient, and only one required treatment for more than four days.

On January 11, 1941, Moorfields was badly damaged. After the repairs had been completed, it was again blasted on May 10th, and the repair work had to be repeated.

The author gives the kitchen staff a special word of praise because on a number of occasions there was neither electricity nor gas, yet there was always a meal of some sort at the right time.

Edna M. Reynolds.

## NEWS ITEMS

Edited by DR. DONALD J. LYLE  
904 Carew Tower, Cincinnati

News items should reach the editor by the twelfth of the month

### DEATHS

Dr. Edward W. Burns, Honesdale, Pennsylvania, died June 21, 1943, aged 71 years.

Dr. Martin L. Matthews, Sanford, North Carolina, died June 12, 1943, aged 68 years.

Dr. Edward L. Neff, Pittsburgh, Pennsylvania, died June 15, 1943, aged 84 years.

Dr. John W. Ferman, Emlenton, Pennsylvania, died June 22, 1943, aged 63 years.

Dr. Burton Thomas Gordon, Pompano, Florida, died July 2, 1943, aged 58 years.

Dr. Arthur R. Turner, Norwalk, Connecticut, died July 2, 1943, aged 80 years.

Dr. Leslie Buchanan, Glasgow, Scotland, died recently, aged 75 years.

### MISCELLANEOUS

The establishment of the William Hamlin Wilder Memorial Foundation has been announced by the Institute of Medicine of Chi-

cago. A gift from Mrs. Wilder made this possible. At the time of his death in 1935, Dr. Wilder was professor emeritus of ophthalmology at Rush Medical College. The first lecture to be given under the auspices of this foundation will be delivered by his son, Dr. Russell M. Wilder. The subject will be "Nutrition and the human eye" and will be presented before the postgraduate assembly on Nutrition in War-time, sponsored by the Institute of Medicine at the Palmer House, Chicago, November 17th and 18th.

The Research Study Club of Los Angeles announces its thirteenth annual mid-winter postgraduate clinical convention in ophthalmology and otolaryngology, January 17 to 29, 1944. As soon as final details are completed the usual complete booklet program will be issued. Those desiring the final program are asked to write

to the Research Study Club, 2509 West Washington Boulevard, Los Angeles.

During and following this meeting will be held: The Western Section meeting of the Triological Society, January 22d and 23d; a special course in "Applied anatomy and cadaver surgery of the head and neck" from January 28th through February 1st; examination of candidates by the American Board of Otolaryngology, February 2d to 5th.

Among the invited speakers will be the following ophthalmologists: Dr. James Watson White of New York and Dr. Georgiana Dvorak Theobald of Oak Park, Illinois; also Irving B. Lueck, M.S., of Rochester, New York, and Dr. Meyer Wiener. At the suggestion of Dr. White there will be made available to all who register for the Clinical Course copies of Duane's "Thesis on motor anomalies of the eye." Those desiring copies should enclose the sum of two dollars in addition to the registration fee (\$50.00).

#### SOCIETIES

Dr. William Thornwall Davis was invited to read a paper on August 17, 1943, before the Asociacion para Evitar la Cegura en Mexico (Society for the Prevention of Blindness) in Mexico City on the subject of "Amblyopia ex anopsia." Because Dr. Davis was unable to deliver the paper personally, the Department of Ophthalmology of the George Washington University School of Medicine made a moving-picture sound film in Spanish of the paper, which was sent by mail to Mexico City and shown before the Association. Dr. Davis read the introductory paragraphs of the paper. Dr. Castillo Najera (George Washington University School of Medicine, 1942) read the main body of the paper before the microphone for Dr. Davis.

The twenty-fourth meeting of the Reading Eye, Ear, Nose, and Throat Society was held on Wednesday, September 15, 1943. Dr. James S. Shipman, of Philadelphia, was the speaker of the evening. He addressed the Society on the topic, "Hypermotropia."

The first autumn meeting of the Brooklyn Ophthalmological Society was held on October

21st, at the Towers Hotel. The scientific program consisted of the following presentations: "Medical aspects of refractive errors" by Dr. John H. Evans, and "Transitory refractive errors (Physico-chemical and physiological considerations)" by Dr. John H. Bailey. The officers of the Society are: Dr. William B. Agan, president; Dr. Michael J. Buonaguro, vice-president; Dr. Benjamin C. Rosenthal, secretary-treasurer; and Dr. Louis Freimark, associate secretary-treasurer.

At the ninety-fourth annual session of the Indiana State Medical Association, held in conjunction with the Ninth Naval District at the Claypool Hotel, Indianapolis, Dr. Peter C. Kronfeld spoke on "Indications for paracentesis of the anterior chamber." Dr. Harry S. Gradle addressed the breakfast meeting.

Major Murray Sanders (M.C.) A.U.S., presented a paper on "Epidemic keratoconjunctivitis" at the fifteenth annual scientific assembly of the Medical Society of the District of Columbia.

#### PERSONALS

Dr. Everett L. Goar, Houston, has been recently appointed ophthalmologist on the clinical staff of the M. D. Anderson Hospital for Cancer Research by the University of Texas.

Dr. Robert J. Masters was recently appointed professor and head of the Department of Ophthalmology at the Indiana University School of Medicine, Indianapolis.

Dr. John E. Weeks, professor emeritus of ophthalmology, New York University, College of Medicine, celebrated his ninetieth birthday recently.

Three of the highest ranking medical officers in the Army of the United States, wearing the eagles of Colonels, are ophthalmologists. They are Colonel Walter V. Moore of Brooklyn, Colonel Henry Templeton Smith of New York, and Colonel Derrick T. Vail of Cincinnati.

Col. Derrick T. Vail arrived in this country just in time to attend the meeting of the American Academy of Ophthalmology and Otolaryngology.

ENDOPHTHALMITIS DUE TO *B. SUBTILIS* FOLLOWING INJURY\*

ALGERNON B. REESE, M.D., AND DEVORAH KHORAZO, M.D.

*New York*

Infections of the eye due to *B. subtilis*, proved by the isolation and culture of the organism on different types of media and its demonstration histologically, have been variously reported during recent years. Organisms of this group are generally considered purely saprophytic for the body as a whole, but can act as pathogens when introduced into the lens or vitreous. It is very doubtful that they can produce disease of the external eye. Known to be common in soil, they may well be introduced into the eye in perforating injuries. Among the cases reported is that of François<sup>1</sup> in which dust caused a mild conjunctivitis cured in 10 days by the instillation of argyrol; the case of Hoffmann<sup>2</sup> in which a perforating injury of the sclera resulted in a ring abscess of the cornea that necessitated the removal of the ocular contents; the two cases of perforating injuries of Motolese<sup>3</sup> with resultant panophthalmitis in one of which, besides the *B. subtilis*, the *Micrococcus citreus* was found, in both cases it being necessary to enucleate the eye; the two cases of Greenspon<sup>4</sup> in which the infection followed a cataract operation and was found to be due to contamination of the saline used to irrigate the eyes; and finally the case of Marchesani<sup>5</sup> in which a perforating foreign body in the region of the limbus gave rise to a chronic intra-

ocular inflammation in the one eye for a period of two months, after which period it became necessary to enucleate this eye because of signs of sympathetic ophthalmia in the other. Axenfeld<sup>6</sup> and Herrenschwand<sup>7</sup> have also very thoroughly reviewed the literature.

## REPORT OF A CASE

A farmer, 56 years old, while chiseling off a shoe from a horse's foot, felt something strike his right eye. Thereafter he noticed progressive loss of vision with very little pain but considerable tenderness on palpation. Two days after the accident, on February 22, 1939, he was admitted to the Institute of Ophthalmology under the care of one of us (A. B. R.). Examination of the right eye revealed an acute iridocyclitis with hypopyon, secondary to an intraocular foreign body. Immediately following the patient's admission, foreign-protein therapy in the form of 5 million typhoid bacilli was given, as well as 1.5 c.c. of *Vibrio* septicum, *B. tetani*, and *B. welchii* antisera. The following day examination of the right eye showed less hypopyon but a more cloudy cornea. There was more exudate at the pupillary margin nasally and some temporally, the pupillary area being almost filled. The tension of the right eye was 43 mm. Hg.

On February 24th a paracentesis was done under local anesthesia. Stereoscopic films of the orbits, projected in the usual fashion, failed to reveal any radiopaque

\* From the Department of Ophthalmology, College of Physicians and Surgeons, Columbia University, and the Institute of Ophthalmology, Presbyterian Hospital.

foreign material in the right eye. A bone-free film of the anterior segment and of the lids of the right eye showed a minute foreign body of metallic density in the anterior chamber, apparently within the lens. On February 25th, the cornea was clear, tension was normal to fingers, and there was some exudate in the anterior chamber. In the evening of the same day the patient complained of constant severe pain in the eye. Examination revealed a very red conjunctiva and a steamy cornea. The anterior chamber was deep and contained considerable pus. The pupil was 2 mm. in diameter and the eye very tender. On February 26th, the anterior chamber was almost completely filled with pus and exudate so that the iris was seen only indistinctly above; tension was normal. On February 27th the exudate and pus in the anterior chamber appeared to be more dense and the iris could be seen less distinctly. Enucleation followed on the eighth day after the injury.

*Bacteriologic findings.* Bacteriologic studies were made from aqueous obtained on the second day after admission to the hospital and from aqueous and vitreous removed from the globe immediately after enucleation. A gram-positive bacillus was isolated in both instances under aerobic conditions. It was found to be spore-bearing and grew on plain agar, forming typical large, rough, subtilis-like colonies. It was nonmotile and nonacid-fast and, judging from its morphologic and cultural characteristics, could be identified as a member of the *B. subtilis* group of organisms.

Microscopic study of gram-stained sections of the enucleated eye revealed gram-

positive bacilli in the anterior chamber, in the vitreous, and beneath the lens capsule.

*Animal-inoculation experiments.* Saline suspensions of the isolated organism in 0.5-c.c. and 1.0-c.c. amounts were injected intraperitoneally into two guinea pigs. The results were negative, ruling out the possibility that the organism could be *B. anthracis*. Five-hundredths cubic centimeters of the same suspension was injected into the anterior chamber of a rabbit's eye. On the third day the eye was inflamed, there was hypopyon, the iris was dull and gray, the pupil small and irregular, and the cornea steamy. These symptoms gradually disappeared.

A portion of the vitreous of the enucleated eye was then injected into the vitreous of a rabbit's eye. On the third day this eye showed slight inflammation, the anterior chamber was shallow, and the iris lost its pink color. There was no ciliary injection. On the eighth day the fundus was hazy and examination showed an abscess in the vitreous. The eye was enucleated and a microscopic study of the sections revealed gram-positive bacilli under the capsule of the lens.

#### SUMMARY AND CONCLUSIONS

A gram-positive bacillus whose cultural and morphologic characteristics identified it as a member of the *B. subtilis* group was isolated from an eye affected with endophthalmitis. The organism was not pathogenic for guinea pigs, but induced endophthalmitis when injected into the anterior chamber of a rabbit's eye. A vitreous abscess in a rabbit was induced by the injection of a sample of the patient's vitreous.

#### REFERENCES

- <sup>1</sup> François, J. Le bacille subtilique en pathologie oculaire. Bull. et Mém. Soc. franç. d'Ophth., 1934, v. 47, p. 423.
- <sup>2</sup> Hoffmann, R. Ueber die Pathogenität des *B. subtilis* für das Auge. Zeit. f. Augenh., 1933, v. 80, p. 124.

- <sup>3</sup> Motolese, F. Due interessanti osservazioni di panoftalmite ed uveite traumatiche ad evoluzione rapida. *Boll. d'Ocul.*, 1936, v. 15, pp. 1023-1034.
- <sup>4</sup> Greenspon, E. A. A pathogenic *B. subtilis* isolated from the eye. *Amer. Jour. Ophth.*, 1918, v. 1, pp. 316-318.
- <sup>5</sup> Marchesani, O. Subtilisinfektion eines Auges mit Erkrankung des andern. *Arch. f. Augenh.*, 1926, v. 97, p. 559.
- <sup>6</sup> Axenfeld, T. *Bacteriology of the eye* (translated by Angus MacNab). London, Bailliere, Tindall, and Cox, 1908.
- <sup>7</sup> Herrenschiwand, F. v. Die pathogenen Mikroorganismen des Auges. Urban and Schwarzburg, 1927, p. 45.

## A STUDY OF MUSTARD-GAS LESIONS OF THE EYES OF RABBITS AND MEN\*

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*London, England*

Mustard gas (dichlorodiethylsulphide) was first used by the Germans at Ypres in 1917. At the time, the large number of casualties, the urgency of the situation, and the absence of facilities for the minute examination of the eyes combined to account for the relatively rare and incomplete studies of the ocular lesion published during and just after the war of 1914-18. Interest in the subject dropped, although occasional case histories and speculations as to after-effects appeared between 1920 and 1935, but after that period interest again revived as it became clear that slightly mysterious cases of recurrent corneal ulceration were occurring among men subjected to relatively heavy doses of mustard gas 10 to 20 years previously. The attention of one of us was first called to these cases of delayed mustard-gas keratitis by Mr. T. J. Phillips, who collected a large number (70) at Moorfields, with carefully recorded case histories and detailed clinical and slitlamp investigations (*Proc. Roy. Soc. Med.*, 1940, v. 33, p. 229 (Sect. of Ophth., p. 5)). It was then apparent that

a large gap existed in our knowledge of the progress of the condition. No records were known of the state of the eyes between the initial stage of the time of exposure and the subsequent onset of recurrent ulceration years after. The patients stated that they had been practically symptom-free during the interval, had continued in ordinary work, and had apparently suffered no visual disability. From the onset of the delayed keratitis, however, they experienced rapid deterioration of sight.

Since the subject of prophylaxis and treatment of mustard-gas lesions of the eyes had again assumed great importance and since improved methods of examination—for example, introduction of the slitlamp—and facilities for experiment were available, we decided to undertake an inquiry into the clinical pathology of the lesion based in the first place on animal experiment and secondly on laboratory accident cases.

The work falls into two sections: (1), experiments on rabbits carried out at the Imperial Cancer Research Fund Laboratory by the kindness of the Council and the Director, Dr. W. E. Gye; and (2), the correlation of the results of animal experiments with recent and late acci-

\* Reprinted by permission from the Proceedings of the Royal Society of Medicine, January, 1942, v. 35, No. 3, pp. 229-244 (Section of Ophthalmology, pp. 1-16).

dent and war cases studied by one of us at the Royal London Ophthalmic (Moorfields) Hospital, and at various experimental laboratories where mustard gas is being handled at the present time.

## PART I

### THE PATHOLOGIC EFFECTS OF MUSTARD GAS ON THE EYES OF RABBITS

A strain of crossed Dutch rabbits with blue irides and a ring of pigmented conjunctival epithelium at the limbus was used for preference. Brown-eyed and albino rabbits are less suitable for observations of vascular changes in the iris and of epithelial healing. Rabbits are suitable since they reproduce lesions almost identical with those seen in man, although they require a larger dose to do so. Their pathologic processes are speeded up in proportion to their shorter expectation of life, and, since the life of a rabbit is roughly one tenth that of a man, a result which would take 10 years to develop in a man may be obtained within a year.\* It has thus been possible to study the genesis of delayed keratitis in 18 months' work.

Rabbits show certain anatomic and physiologic differences from man which are useful from an experimental point of view. Their corneas are relatively insensitive and their blinking reflex is often delayed for 20 minutes. It is therefore possible to keep the eyes open during long periods of observation without introducing complications due to abnormal drying of the cornea. The normal rabbit cornea usually shows a faint punctate staining with fluorescein from minute injuries with foreign bodies and from drying; but the epithelium is resistant, and spontaneous ulceration or even conjunctivitis is rare. The possibility of infection

is therefore not great, and the induced lesions can be studied in their uncomplicated state. The greater area of the cornea relative to the sclerotic in rabbits makes them rather more suitable than is man for the study of corneal lesions and less so of combined conjunctival and corneal lesions. The fact that the vessels corresponding to the major circle of the iris are in rabbits visible through the cornea is also an advantage when early stages of iritis are under observation, while the palpebral aperture is sufficiently wide to allow of the examination of the limbus all round, which cannot be done in the smaller experimental animals such as guinea pigs and rats.

We found by experiment that the sequence of events following the application of mustard gas to the eye varies very considerably with the technique of the application and that these variations are dependent on the anatomic site at which the mustard comes in contact with the eye, on the time it remains in contact, and, therefore, on the size of the dose. For these reasons it was decided that a detailed study of the local lesion produced by a constant dose confined in turn to (a) the cornea, (b) the limbus, and (c) the lids and conjunctiva would give more information than the application of varying concentrations to the whole eye and adnexa at once, although this also was studied when severe effects were required.

If every precaution is taken to ensure similarity of dose and accuracy of application, the results obtained are of great constancy and suggest an inevitable chemical reaction rather than a biologic response subject to individual variation. These results will be considered first with reference to anatomic site.

\* This calculation is based on observations made on spontaneous cancer in man and animals and on the induction of cancer by means of carcinogenic agents. It can be shown also that this rough proportionality exists in healing lesions. It has been borne out in the present paper.



### (1) THE UNCOMPLICATED CORNEAL LESION

Observations were made on 33 eyes in this group.

The rabbit is anesthetized with ether and laid on its side. This is necessary on account of the peculiar oily consistency of liquid mustard, which tends to slide about on the eye under the action of gravity and which, unless carefully controlled, may not exert its action at the apparent site of application. To see the liquid mustard more easily and thus control it, a small quantity of sudan black is added. This makes it visible on a blue eye and does not modify its action in any way. In the experiments which follow, the mustard gas used was an impure sample of the liquid. The lesions are thus likely to be comparable with those expected in man. The application is made with a glass rod having a small rounded end 0.25 mm. in diameter. The tip is dipped in the liquid mustard gas and applied lightly to the cornea without abrading the epithelium. From three to nine spots of mustard are used, arranged in a circle in the central area. The diameter of this circle should be less than two thirds the diameter of the whole cornea, otherwise the limbus may become involved by spreading. The lids should be held open for 15 minutes, either by hand or with a speculum. At the end of 15 minutes the liquid mustard disappears, leaving a thin film of sudan black on the surface of each spot. This may be removed by touching lightly with filter paper or may be left. The eye is then allowed to close and the rabbit to recover. In some cases the rabbit was not anesthetized, and the application did not appear to be painful. The sequence of events was then studied in detail.

*Observations—Day of application.* The liquid mustard tends to slide unless the

center of the cornea is maintained in an upward-facing position for four minutes. After four minutes there is practically no tendency to slide. The small droplet is at first hemispherical and projects from the surface of the cornea. After about a minute it often changes its shape, puts out pseudopodia, and begins to slide. From observations on sliding droplets it is possible to say that contact for two to three seconds is sufficient to destroy the epithelium. If a droplet remains in contact for longer than this it begins to penetrate the substantia propria. It reaches Descemet's membrane and endothelium in two minutes. In 6.5 minutes (average) it has passed through the cornea and the aqueous and has reached the iris, where it produces localized hyperemia. In most cases the hyperemia gradually spreads to involve the whole iris. In four minutes none of the droplet remains on the surface. If droplets be placed over a sector of the iris and not in the center of the cornea the small radial vessels running from the major circle towards the pupil will be seen to flush first (fig. 1, Plate 4). After a few minutes more the larger vessels running peripherally from the major circle dilate also. This flushing of the iris may persist as an iritis lasting some days accompanied by aqueous flare, and occasionally there is a true exudate in the anterior chamber.

As the droplets soak into the cornea they appear to dig little pits in the epithelium into which they gradually sink. Abundant clear or milky tears\* are poured out immediately.

If fluorescein is dropped into the eye within a few minutes of the application of the mustard there will be no staining. In a quarter to half an hour the points of application are stained, but nothing else. As the effect of the mustard spreads

\* The milky secretion appears to well out from under the third eyelid and is probably Harderian.

the stained areas increase so that at 24 hours there is a large central stain embracing all the spots of the application. This may increase further up to 48 hours, although it usually begins to heal at about 30 hours.

There is no immediate change in transparency of the cornea, and in unanesthetized rabbits the application does not appear to be at all painful. After some hours the eyes look a little watery and there is some hyperemia of the conjunctiva. There is no visible change in the substantia propria on the first day. Slit-lamp examination reveals damage to the endothelium which shows a "beaten silver reflex."

*After 24 hours.* The conjunctival hyperemia has increased slightly, but there is no discharge, beyond occasionally a little dried mucus at the inner canthus. The lids show no abnormality.

The area of staining in the center of the cornea is circular and includes all the spots of application. Occasionally the exact sites of the droplets can be seen as small grayish dots within the stained area. The stain penetrates the whole thickness of the cornea more rapidly than normal and diffuses into the aqueous in from three to five minutes.\* The grayish areas, that is, the worse affected areas, often take up the stain less well than the region just surrounding them (fig. 2, Plate 4). The area involved therefore shows a central region over which the epithelium is destroyed and within which there are denser gray spots marking the sites of the droplets. The large area of destruction of the epithelium is due probably in part to the spread of the mustard by soaking into the tissue in all directions and partly to a vapor effect from evapora-

tion of the droplets during the time in which they are on the surface.

The epithelium surrounding the staining area is edematous (epithelial bedewing) and if the diameter of the stained area is two thirds that of the cornea this bedewing will extend to the limbus. Otherwise the edges of the cornea will be normal.

The substantia propria of the cornea is now no longer transparent, but shows a grayish haze in the central region. This is due to edema, which separates the fibers and gives a very characteristic slitlamp appearance of dark (optically empty) spaces outlined by irregular fluffy whitish partitions (fig. 3, Plate 4). This appearance is most conspicuous in the superficial third of the substantia propria. The cornea may be swollen to twice its normal thickness or more in severe cases.

The endothelium may be completely destroyed in the center of the lesion or may show a disturbed reflex like beaten silver.

*At two days,* the staining area is usually smaller, but the endothelial disturbance and the edema of the substantia propria are worse. There is a zone of epithelial bedewing around the staining area, and beyond that single hydropic cells can be seen here and there in the epithelium some distance away. These cells, seen as single, bright, shining points, are also characteristic of recent lesions of moderate severity in man. There is no discharge.

*At three days* there is still slight conjunctival hyperemia, but no discharge and no abnormality of the lids. There may be a small central staining area, but in the smaller lesions this has usually disappeared, and the epithelium is intact though still bedewed. The edema of the

\* If the epithelium is mechanically removed from a rabbit's cornea and fluorescein dropped in, the stroma is stained halfway through in 5 minutes, all through in 10 minutes, and in 12 minutes the endothelium is stained and the color begins to appear in the aqueous.

substantia propria is lessening, and as it subsides the cornea returns to its normal thickness but not to its normal texture. Instead of its usual homogeneous and slightly speckled appearance it now shows a series of thin shiny curved lines, running in all directions and looking rather like fibrils of silk floss scattered throughout the thickness of the cornea (fig. 4, Plate 4). This "silkeness" is best seen in the broad beam of the slitlamp. In the narrow beam the cross sections of the silky lines show up as scattered bright dots and short, shiny, stratified lines. Silkeness is first seen on the third day in a zone, around the center of the lesion, where the edema is subsiding. As this subsidence continues the silkeness increases until the whole of the central area shows it. The endothelial disturbance is still present, but the area of destruction is lessening.

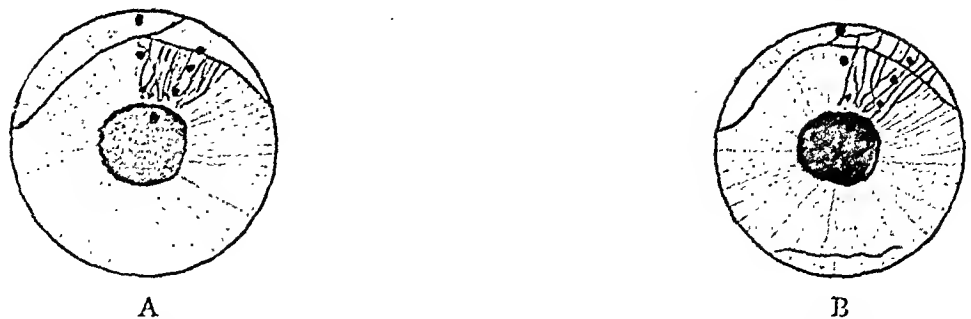
*At four days* there is no staining of the epithelium, and the bedewing and edema are less. The lesion can be resolved into three concentric zones. The center shows some edema of the substantia propria. Surrounding this is an area of "silkeness"\* which corresponds to the area of endothelial disturbance and outside this again is the outer edge of the area of epithelial bedewing. Thus the largest circle represents the area of damage to the epithelium, with a smaller zone within it in which the substantia propria and the endothelium are altered. The endothelium can be seen regenerating at the edges of the patch of destruction.

The lesion is therefore practically quiescent at four days. The edema continues to subside and its place is taken by the silky appearance.

\* An explanation of the anatomic basis of "silkeness" had been put forward in our paper, "Avascular healing of the cornea" (Pullinger and Mann), Jour. of Path. and Bact., 1943, v. 55, p. 151.

*At seven days* there is no edema and only slight epithelial bedewing in the center. The silky change is well developed and the endothelium still shows a disturbed reflex. The eye looks perfectly quiet and normal to macroscopic examination. The silky change if excessive may show as a very faint nebula in certain lights, but is difficult to see without a slitlamp. It appears to be more or less permanent, although in the course of months it becomes less marked. The endothelial disturbance disappears completely in time and it is usually gone at 11 days. The epithelial bedewing lasts the longest and may persist in the center for several weeks (up to five in a nine-spot lesion). In man it lasts much longer, and there is some evidence that it may be permanent although very slight. Isolated hydropic cells can be detected for a long time in both man and rabbit, after the eyes look absolutely normal to superficial examination.

The appearance and course of this central lesion affords a striking example of some of the physical and chemical properties of mustard gas. That the liquid penetrates with remarkable rapidity is shown by the fact that it passes through the cornea and aqueous in  $6\frac{1}{2}$  minutes. It is, as it were, soaked up by the cornea and spreads widely within it and throughout the deeper structures also, until it has become sufficiently diluted or broken down to cease to act. On its passage through the cornea it changes the fibers, and kills epithelium, corneal corpuscles, and endothelium. The epithelium and endothelium are replaced by cells from beyond the lesion, but the substantia propria, although permanently altered, is not cast off as a slough; after a brief period of edema, it returns to its normal thickness although it still shows a pathologic change which may be permanent. Since the cor-



Figs. 1 to 4 (Mann and Pullinger). Fig. 1. A, The dilatations of the smaller radial vessels in one sector of the iris 6.5 minutes after application of liquid mustard gas to the spots indicated in black. B, The same eye at 10 minutes. The peripheral vessels are dilated as well.



Fig. 2. Appearance of cornea in narrow beam of slitlamp in the region of two spots of liquid mustard gas (after 24 hours). These are shown by darker shading and are thinner than the surrounding paler area, which stains more deeply than they do.



Fig. 3. Appearance of corneal edema in the narrow beam of the slitlamp.



Fig. 4. Appearance of "silkeness" in the broad beam of the slitlamp.

nea is not vascular we can thus see the action of the mustard on a tissue uncomplicated by coincident disturbance of circulation, except at the limbus where there is slight hyperemia. It is interesting to note that even in the absence of capillaries, edema is a prominent feature of the lesion.

## (2) THE LESION INVOLVING THE CORNEO-SCLERAL JUNCTION

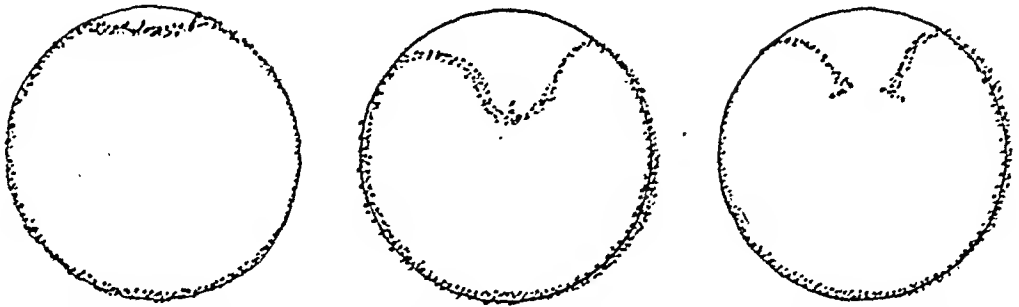
The lids of some rabbits were held open with a speculum. Other rabbits were anesthetized. Five to nine droplets were applied to a sector of the cornea in the shape of a V with the ends of the two limbs on or near the limbus. The treated eyes were kept open for 15 minutes after the application, in all cases, except those in which the speculum accidentally fell out. In this way a certain variety of lesions was produced: In some cases all the nine spots were effective; in others, some of the spots were not so large as others; and in some the third eyelid brushed over the cornea before 15 minutes had elapsed, or the lids partially closed. Thus it was possible to study a series of lesions, varying from a pure corneal and corneoscleral lesion to one of moderate severity involving the third lid or the margin of the upper lid as well. A further series of experiments to be dealt with later, was done, using a single measured drop placed on the cornea, the eye being allowed to close immediately, so that the drop spread to the cornea, limbus, ocular and palpebral conjunctiva, and the lid margins.

(i) SECTORIAL LESIONS OF MODERATE SEVERITY. Fifty-one eyes were observed in this group. Not all the rabbits were anesthetized. The spots (five to seven) were placed in a V-shaped area at the upper part of the eye, the apex of the V at the

center of the cornea and the two limbs on the corneoscleral junction (see fig. 1, Plate 4).

*Observations.* At the time of application the eyes water slightly but there does not appear to be pain in the unanesthetized animals. In about six minutes the section of the iris underlying the V becomes hyperemic, the radial vessels running toward the pupil first and then the larger vessels peripheral to the major circle (fig. 1, Plate 4). In 10 minutes the conjunctiva at the limbus becomes slightly swollen. In two or three hours there is a small fleck of mucopus at the inner canthus, the conjunctiva in the sector of application is more swollen, and the spots stain individually. The hyperemia of the iris vessels spreads so that the whole iris is engorged in five hours. In six hours there appears to be slight photophobia, and the eyes are kept half shut. In seven hours the slitlamp shows an aqueous flare (increased albumin content of aqueous). The corneal changes are as previously described.

*In one day* the eyes are open with slightly drooping lids, conjunctivas are hyperemic, and flakes of mucopus are found at the inner canthi. If this discharge dries on the fur of the lower lid it may produce a mechanical ectropion which disappears on washing the lid. The whole of the sector of application, not only the spots, now stains with fluorescein and also the edematous conjunctiva at the limbus opposite it. The stain on the conjunctiva is orange, that on the cornea green and shows unusually rapid penetration, apparently due to damage to the stroma (substantia propria), allowing the dye to soak through. If the epithelium is mechanically removed from the rabbit's cornea and fluorescein dropped on, the color begins to appear in the aqueous in



Figs. 5 to 8 (Mann and Pullinger). Fig. 5. Some varieties of pigment slide formed during healing of the sectorial lesion.

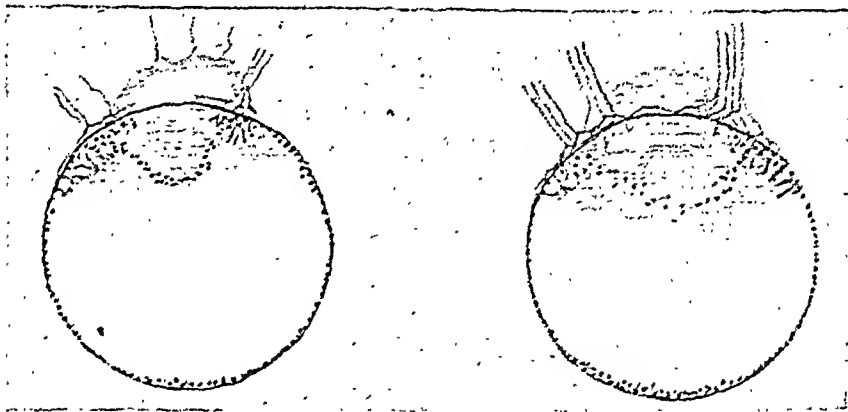


Fig. 6. Diagram of a cornea showing progress of invading vessels. The injury is a sector in the upper part. The pigment slide is shown and the shaded portion is edematous. The vessels enter first through the undamaged limbus.

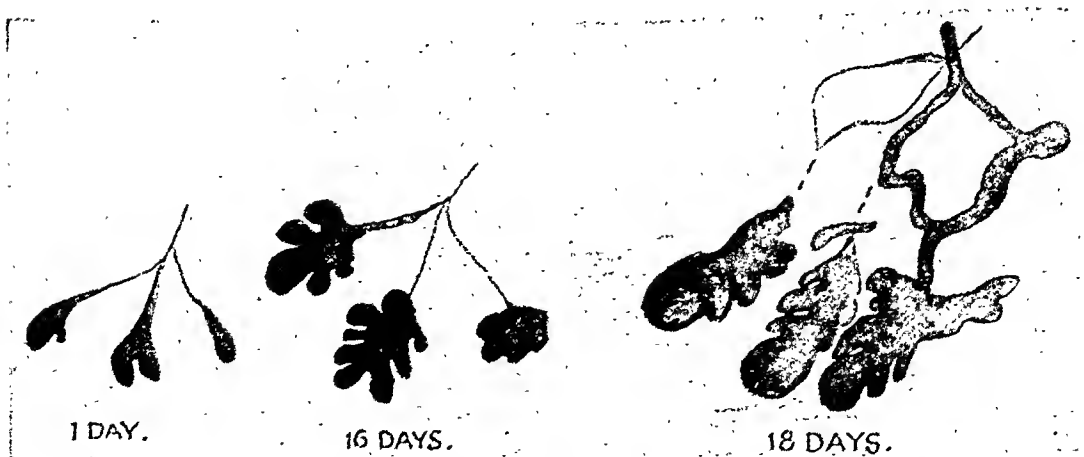


Fig. 8. The genesis of a group of blood islands, with constriction of their feeding vessels.

12 minutes, but in the mustard-gas injury the fluorescein passes into the aqueous in from three to five minutes.

There is destruction of epithelium in the staining area and bedewing over a wide area but not over the whole cornea. The substantia propria in the sector is edematous (primary edema), and the spots of application may look denser than the rest as in the central lesion already described. There is the endothelial disturbance previously described, or destruction. The pupil may be sluggish and there is hyperemia of the iris and an aqueous flare. In some cases a gelatinous exudate can be seen coming from the sector of the iris corresponding to the sector of application.

*In two days* there is still slight mucopurulent discharge and where it sticks to the fur this tends to fall out, but the lids are not glued together, although they may be slightly swollen. The epithelium is beginning to cover the denuded area by sliding from the healthy parts. This can be seen in brown- and blue-eyed rabbits as the pigmented conjunctiva at the limbus slides over the cornea carrying the pigment with it (fig. 5, Plate 5). This pigment slide begins in about 40 hours and continues for three days; that is, until the epithelium can no longer be stained. The new areas of epithelium show bedewing. The substantia propria is more edematous in the sector and just beyond, but the penetration of fluorescein is not quite so rapid. The iritis is subsiding.

The conjunctiva at and between the points of application at the limbus is edematous, quite white, and no blood vessels can be seen in it. There is usually a line of hemorrhage at the limbus and sometimes above the pale area. The surrounding conjunctiva is hyperemic.

*In three days* the staining area is less, and the discharge is clearing up, unless the lids have been accidentally touched,

when it persists longer. The corneal edema has increased slightly, and the migration of pigmented epithelium has progressed. The edema is mostly of the superficial third of the cornea.

*In four days*, as a rule, the staining has almost or completely disappeared (as in the central lesion), and the pigment is scattering over a wider area and disappearing. The edema of the substantia propria is less and is confined to the sector. In the conjunctiva there is increased capillary activity at the margins of the pale area, and the limbal loops on either side of it are engorged. The eye on the whole looks better.

*In five days* there is no stain, practically no discharge, and the edema is much better, although still present in the sector just at the limbus. The conjunctiva is not hyperemic except just at the limbus, at the edges of the pale patch where the limbal loops are active. The iritis has disappeared.

*In six days* the eye looks macroscopically quite quiet except for a very faint haze above. The edema (primary edema) has practically disappeared, but the slit-lamp shows great activity of the conjunctival vessels at the edges of the pale area (fig. 6, Plate 5). If the eye is observed only until this stage it would be passed as practically cured, and so far the course is that of the pure corneal lesion except for the damage to the vessels at the limbus.

*In nine days*, however, a marked change for the worse is apparent. The conjunctival vessels are beginning to invade the cornea at the edges of the sector, not only superficially, but also at all levels, most of them being about one third the way through. These invading vessels are accompanied by a considerable increase in the edema of the substantia propria (secondary edema) which just precedes them and spreads through the sector as the ves-

sels advance. The rest of the conjunctiva is not hyperemic and there is no fresh discharge, but the cornea begins to look worse.

*In 11 days* the invading vessels are well established and the secondary edema is considerable. The appearance is often like the typical "salmon patch" of interstitial keratitis in man, with the difference that although the vessels in the cornea are at varying depths they all originate from the superficial conjunctival vessels and not from scleral branches. The advancing capillaries are peculiar and their distribution characteristic. They grow in as fine straight vessels with tapering ends which do not yet curve round to make a return channel. Close observation with a slitlamp magnifying 25 times fails to reveal any movement of the blood in these tips, which are packed close with corpuscles. The ends often branch at right angles, or right-angled branches occur nearer the source of the vessels. The blood appears to clot in many of the tapering ends; intracorneal hemorrhages spread out from them; hemolyzed blood can sometimes be seen seeping along the corneal fibers. More often the tapering ends of the vessels become detached. This detachment is usually followed by the formation of a channel for a return supply at the proximal end. Some of the invading vessels have bulbous ends and assume fantastic shapes, detached points, branches, and islands of blood being constantly formed, disappearing and reappearing rapidly, the whole pattern varying from day to day, always extending farther into the cornea, and always accompanied by secondary edema (fig. 7, Plate 6). The patterns assumed by these invading vessels suggest that they are growing unchecked into spaces formed by splitting apart by edema of altered corneal fibers. Their arrangement is not unlike that of the so-called Bowman's

canals, an artifact produced by splitting a cornea by forcing air into it, which shows the same bulbous ends and right-angled branchings. On the other hand, their arrangement often differs entirely from that of blood vessels grown experimentally in the transparent Sandison-Clark chambers in the rabbit's ear. The vascularization spreads and increases from the eleventh to the thirtieth day or longer. The pale area of conjunctiva (which has been killed) is invaded by regenerating vessels which, in turn, spread to the cornea, but the first and greatest invasion is from the edges of the sector, through the uninjured limbus. Most of the vessels lie one third the way through the cornea. After 30 to 35 days the supply vessels begin to narrow, the circulation slows, the tapering ends disappear, and the remaining vessels narrow down and gradually become more regular. The edema subsides simultaneously. The pigment line which is broken at the limbus may partially reform. The pigment scattered on the surface of the cornea disappears, and the eye begins to improve again. As the corneal edema subsides the silky appearance mentioned in describing the pure corneal lesion becomes visible throughout the greater part of the sector.

By about the sixtieth day or less the secondary edema has all cleared up, leaving only the silkiness, which is more or less permanent; that is to say, it has disappeared after more than a year in a few rabbits. The hemolyzed blood disappears as do many of the vessels. Those remaining become fine and regular in arrangement and are often empty. They can be made to fill up temporarily by gently rubbing the eye through the closed lids. Slight changes such as endothelial disturbance, faint pigment speckling, and faint epithelial bedewing may persist for three months. Indeed, slight epithelial bedewing and Hassall-Henle bodies on the



endothelium may remain almost indefinitely. Such an eye, however, does not seem in danger of relapse.

(ii). **SECTORIAL LESION OF GREATER SEVERITY WITH SLIGHT LID INVOLVEMENT.** Thirty-nine eyes were observed in this group. If nine spots are applied and the limbus and conjunctiva slightly more injured than in the preceding series, as well as possibly a small area of the lid margin or the third lid, the course of the process is lengthened and various further changes occur. These can be classified as: (a) increased discharge, (b) recurrent thromboses, (c) formation of blood islands, (d) deposition of cholesterin and fat, and (e) persistent edema, formation of fibrous tissue, and cellular infiltrations.

(a) and (b). *Increased discharge and recurrent thromboses.* The lesion is at first similar to one of moderate severity except that the discharge persists longer, especially if the third lid has been injured. The edema of the substantia propria, both primary and secondary, involves not only the sector of application, but the whole cornea, and the newly formed vessels are more exuberant. The clearing up of the primary edema at the end of the first week is not so complete. The condition begins to clear up at about 60 days as before, but instead of steadily subsiding it shows exacerbations about every fortnight after that, with fresh ingrowth of vessels, increase of edema, and thromboses and intracorneal hemorrhages which begin to clear up again and then recur. These events may continue for six or nine months or more, and then finally cease, the vessels narrowing and the edema subsiding, but probably relapses are always possible, since many vessels remain in the cornea.

(c) *Blood islands* (fig. 8, Plate 5). In some lesions similar to those described above the intracorneal hemorrhages take the form of large blisterlike collections of

blood, usually in the most superficial layers of the substantia propria. The vessels of supply constrict and disappear but the "blood islands" remain for many months. There appears to be no great stimulus for their removal, such as exists in connective tissues.

(d) *Deposition of cholesterin and fat.* In some instances of severe vascularization, especially if there is one large vessel of supply arborizing freely toward the center of the cornea, the regression of the vessels at about three to four months may be accompanied by the deposition of cholesterin crystals, first outside the vessel walls and later over the whole area previously occupied by them. As the vessels retrogress the cholesterin is left behind, often in the form of a semilunar glistening opacity, with its concavity towards the main supply vessel (fig. 9, Plate 7). Fatty degeneration visible with the slitlamp as opaque, flocculent, white masses may follow the cholesterin and both may be present together. The eye may be fairly quiet after six to seven months. If it be watched, however, it will be seen to break down again in about seven to eight months, the cholesterin apparently working up to the surface, causing ulceration of the epithelium and being cast off with loss of substance, so that a small pitted scar is left. The fatty degeneration also may lead to recurrent secondary ulceration. These eyes continually heal and break down, each small ulcer staining for about four days. In some cases, however, the cholesterin is deposited in the deeper layers near Descemet's membrane, where it does not cause secondary ulceration and remains unchanged; in others it disappears without ulceration.

The lipoid occurs in these forms: 1. As exceedingly fine droplets like an emulsion bathing the fibrils of the substantia propria. The fibrils themselves appear to remain intact. More work using silver im-

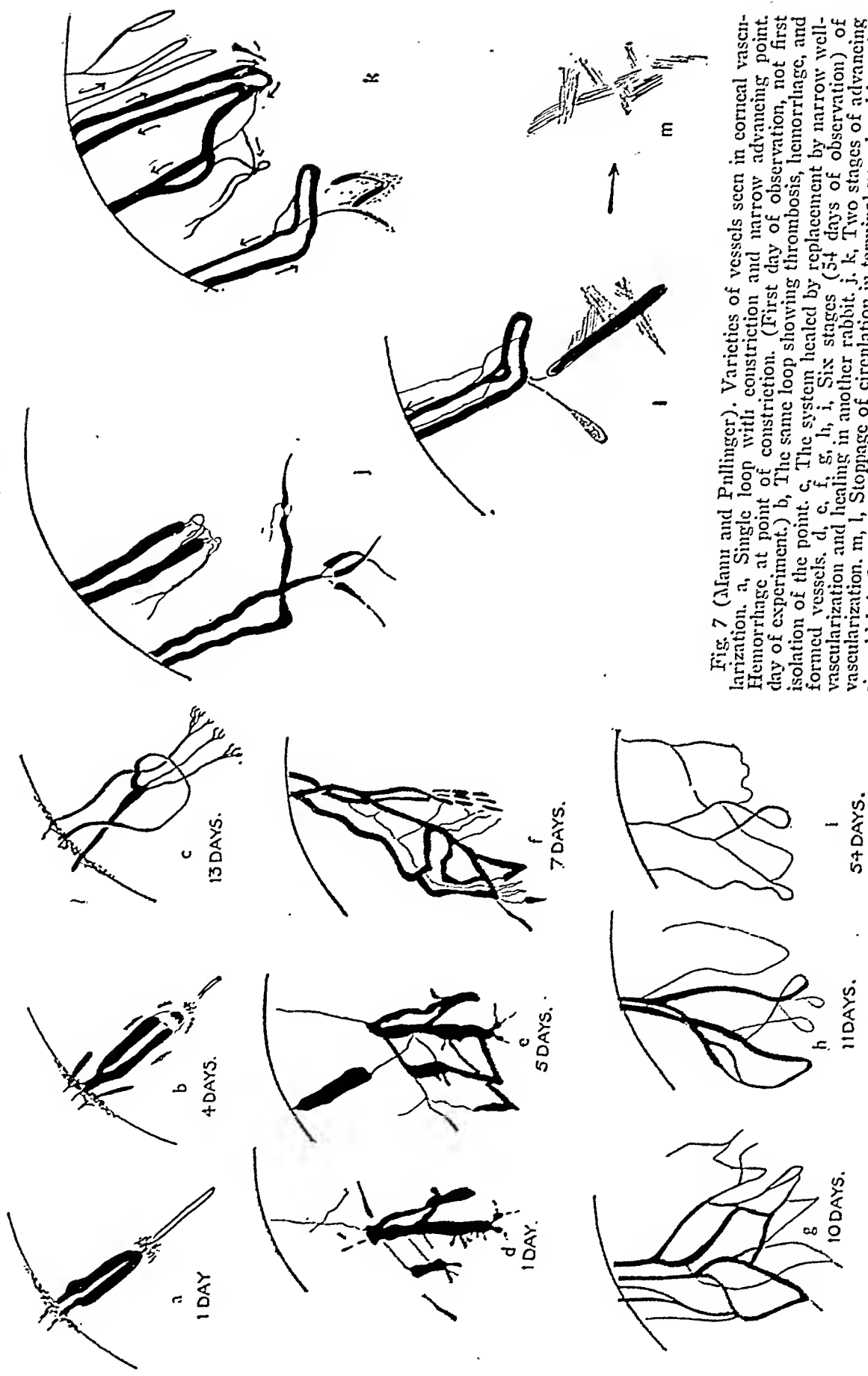


Fig. 7 (Mann and Pnllinger). Varieties of vessels seen in corneal vascularization. a, Single loop with constriction and narrow advancing point. Hemorrhage at point of constriction. (First day of observation, not first day of experiment.) b, The same loop showing thrombosis, hemorrhage, and isolation of the point. c, The system healed by replacement by narrow well-formed vessels. d, e, f, g, h, i, Six stages (54 days of observation) of vascularization and healing in another rabbit. j, k, Two stages of advancing vascularization. m, l, Stoppage of circulation in terminal vessel and hemolysis, which is finally all that can be seen.

pregnation requires to be done to settle this point. The droplets are stained with the usual fat stains; for example, Scharlach R, Sudan III and IV, and Sudan Black. They are not doubly refracting in polarized light. They occur at any level of the substantia propria.

This distribution of lipid was found in a sulphuric-acid burn in a human eye which we had the opportunity of examining.

2. As large intracellular globules and crystals having the characteristics of esters and cholesterin. These are: (a) double refraction in polarized light, (b) appearance of double "Maltese crosses" in polarized light, (c) disappearance of double refraction on heating, (d) reappearance of double refraction and of crystals on-cooling, and (e) capacity to be stained with the usual fat stains. The cells containing the crystalline lipid are macrophages. They appear in and around the deposits of emulsified fat, also when no emulsion is present. 3. As fine intracellular globules of isotropic fat in adventitial cells and possibly endothelial cells also of blood capillaries in eyes that have, and in others that have no actual "lipoid scars." 4. As free cholesterin crystals with: (a) a characteristic appearance in the slitlamp beam, (b) double refraction in polarized light, (c) crystalline structure when seen with high microscopic magnifications; namely, flat crystals with corners "bitten out." The emulsified lipid and the crystalline lipid may be quite distinct or may be stages of a process related in time. Appearances suggest that the fine globules are ingested by macrophages and converted by them into cholesterin esters. Further work is required to settle this point.

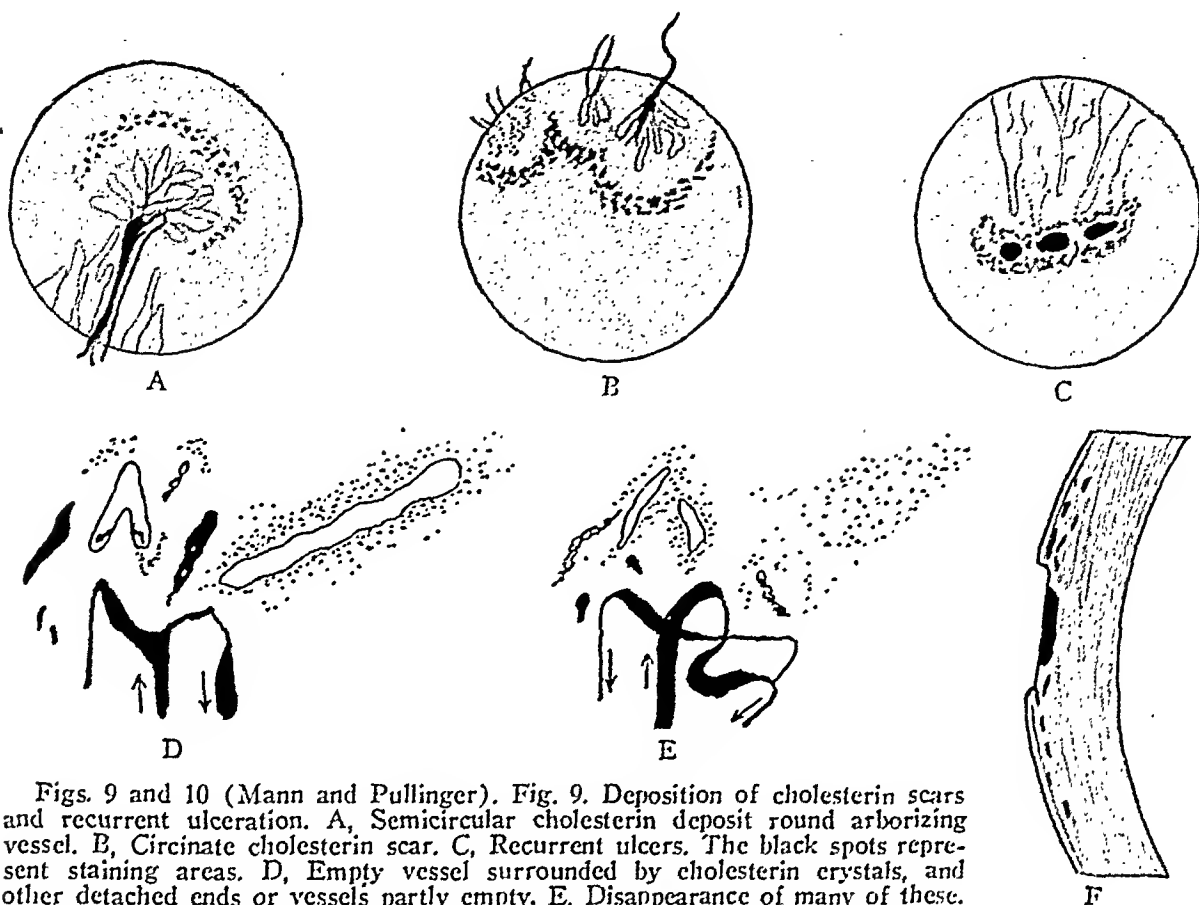
(e) *Persistent edema and formation of fibrous tissue.* When the eye and lids have been more severely injured and the discharge has been greater and more pro-

longed, there may be no tendency for the edema to clear up (fig. 10, Plate 7). The primary edema may merge with the secondary edema and the whole cornea may become completely waterlogged and enormously swollen up to 20 times its normal thickness. This may persist, with repeated thromboses and exuberant vascularization for months. Large blisterlike collections of fluid form among the superficial fibers of the substantia propria and occasionally though not often between the epithelium and Bowman's membrane. The surface becomes irregular, corrugated, and thrown up into ridges and circular blebs. In these the corneal structure is entirely replaced by very vascular fibrous tissue which may invade the larger part of the cornea. These edematous, thickened, fibrous corneas never clear and show a great tendency to secondary ulceration and to surface keratinization. Large superficial ulcers may occur after about seven months (fig. 11, Plate 8). They may take a week or longer to heal and then break down again. They are much larger and more persistent than the small ulcers associated with cholesterin noted above. Some of these corneas have been observed for 9 or 10 months and show no tendency to stabilize or resolve.

In some cases the blisters and blebs become filled with pus and indeed in all these severely injured eyes there is persistent discharge. How great a part infection plays in keeping up the edema is not yet clear, but it seems likely to be of more importance in cases where the lids are injured severely as well as the cornea and limbus.

### (3) SEVERE LESION OF THE WHOLE EYE AND LIDS

Fifteen eyes were used in this group. If a large measured drop (approximately 0.0005 c.c.) be placed on the cornea and the eye allowed to close, a generalized



Figs. 9 and 10 (Mann and Pullinger). Fig. 9. Deposition of cholesterol scars and recurrent ulceration. A, Semicircular cholesterol deposit round arborizing vessel. B, Circinate cholesterol scar. C, Recurrent ulcers. The black spots represent staining areas. D, Empty vessel surrounded by cholesterol crystals, and other detached ends or vessels partly empty. E, Disappearance of many of these. F, Position of cholesterol in C at edge of ulcer seen in narrow beam.

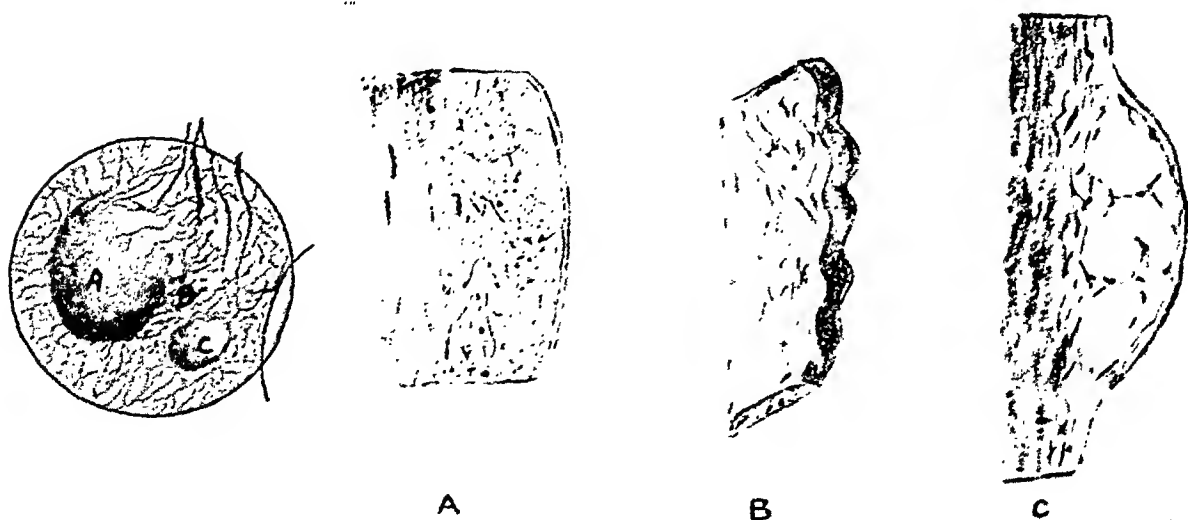


Fig. 10. Appearance of cornea of badly injured eye. A, Section (narrow beam) through the blister-like protuberance at A. This shows fibrils in a jelly-like matrix filled with minute bright spots, the blood vessels (black) running deep to this. B, A broader beam section through B, showing formation of fibrous tissue with blood vessels running among the new fibrils. C, Section (narrow beam) through the bleb at C. The fluid is in spaces in the superficial layers of the stroma and not truly subepithelial. There is granulation tissue in the angles, invading the bleb, which will in time become completely converted into solid vascular connective tissue.

lesion of great severity is produced. The reaction is too great to study the early stages in detail. For the first 9 days the eyelids and ocular and palpebral conjunctiva are so swollen and edematous that it is impossible to see the cornea. There is copious discharge which glues the lids together and mats the fur and causes it to fall out over a wide area around the

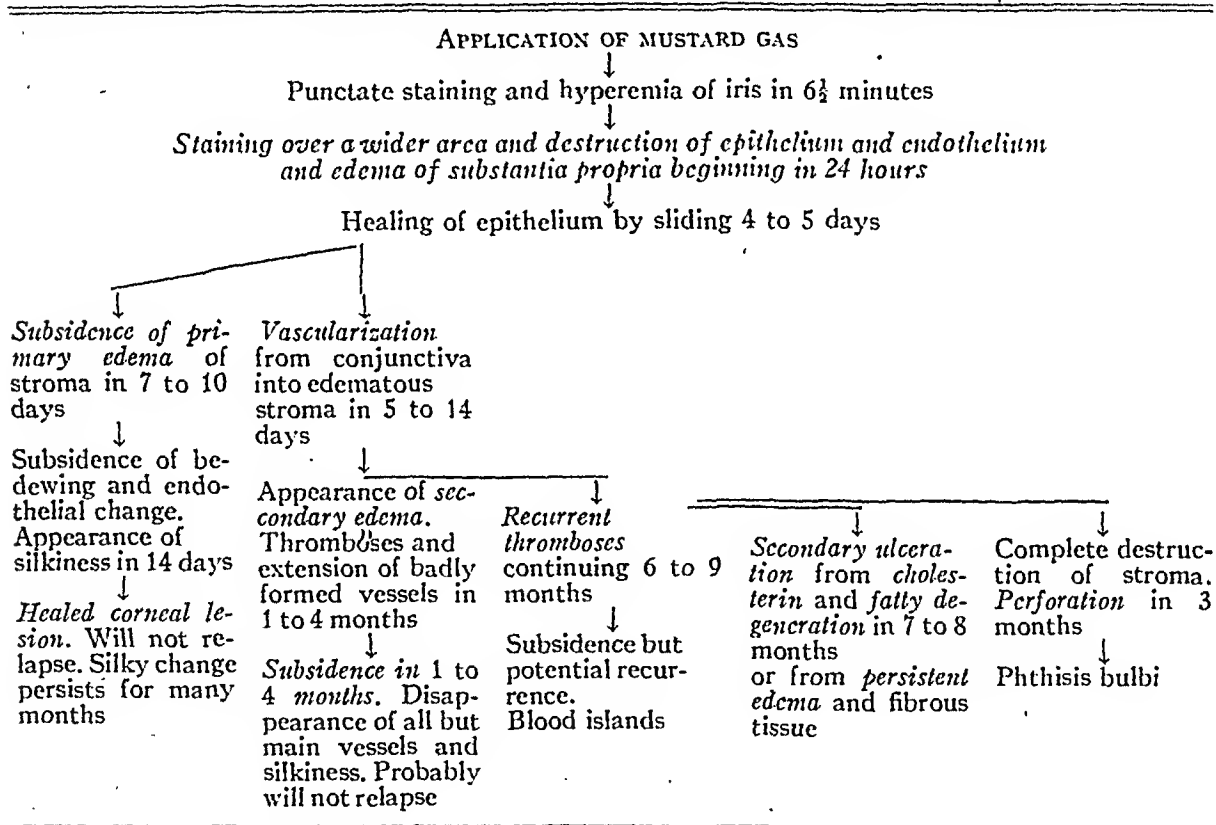
ing rise to a descemetocoele which eventually ruptures, with collapse of the eye, infection, panophthalmitis, and finally phthisis bulbi, with a shrunken globe, deformed lids, and chronic discharge.

## COMMENT

These possibilities can be tabulated (see table 1). They correspond very closely,

TABLE 1

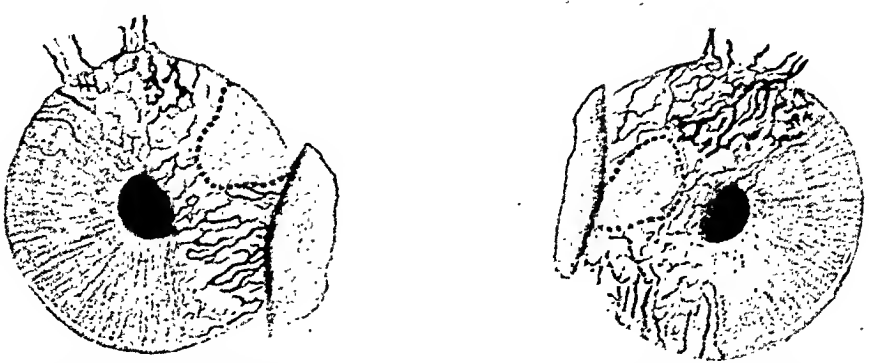
COURSE OF MUSTARD-GAS LESIONS OF RABBIT CORNEA COMPILED FROM OBSERVATIONS ON 138 EYES



eye. As the swelling decreases and it becomes possible to see the eye, the lids become notched or "ruffled" and everted so that the lower lid especially is not properly in contact with the globe and is constantly covered with discharge.

The corneas are richly vascularized and excessively edematous. Necrosis of the cornea may be so extensive that in two-and-a-half to three months the substantia propria will appear to deliquesce and disappear over a large or small area, giv-

although much condensed in time, with the lesions seen in man, including the "delayed keratitis" still affecting men exposed to mustard gas in the last war. Edema, persistent epithelial bedewing, nebulae and silkiness, vascularization, recurrent thromboses and intracorneal hemorrhages, curiously shaped vessels, blood islands, cholesterolin, fat, recurrent ulceration, perforation, and phthisis bulbi have all been observed in man, so that there seems good ground for supposing



Figs. 11 to 17 (Mann and Pullinger). Fig. 11. Two eyes of rabbit with recurrent ulceration from persistent edema and fibrous-tissue formation. The areas surrounded by the dotted lines stain with fluorescein.

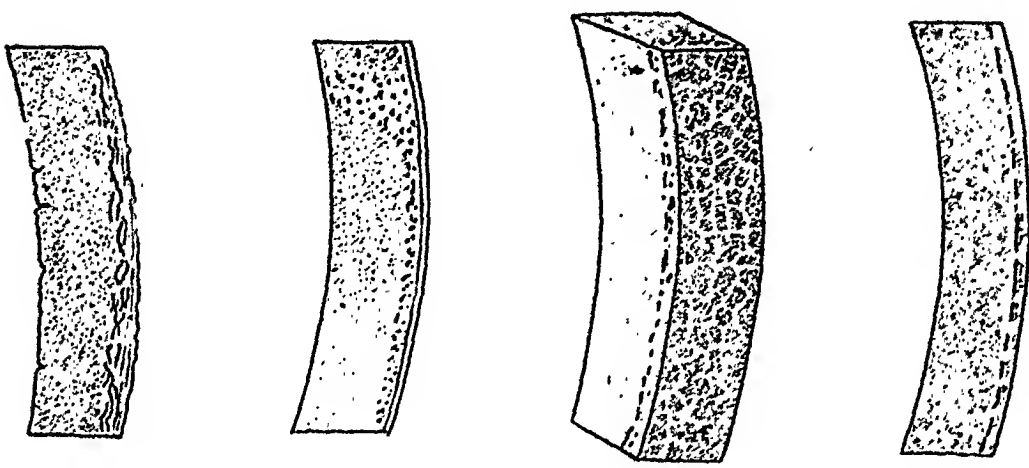


Fig. 12                      Fig. 13                      Fig. 14                      Fig. 15

Fig. 12. Appearance of cornea in case 4 (Group 3) in the narrow beam of the slitlamp at one week. The epithelial surface and edema of the substantia propria are to the right, the endothelial irregularity to the left.

Fig. 13. Appearance of cornea in case 4 (Group 3) in the narrow beam of the slitlamp at three weeks, showing shiny dots in the substantia propria (cf. fig. 12).

Fig. 14. Appearance of superficial dappling in case 4 (Group 3) seen in broad beam at 5½ weeks.

Fig. 15. Case 4 (Group 3) seen in narrow beam at 5½ weeks.

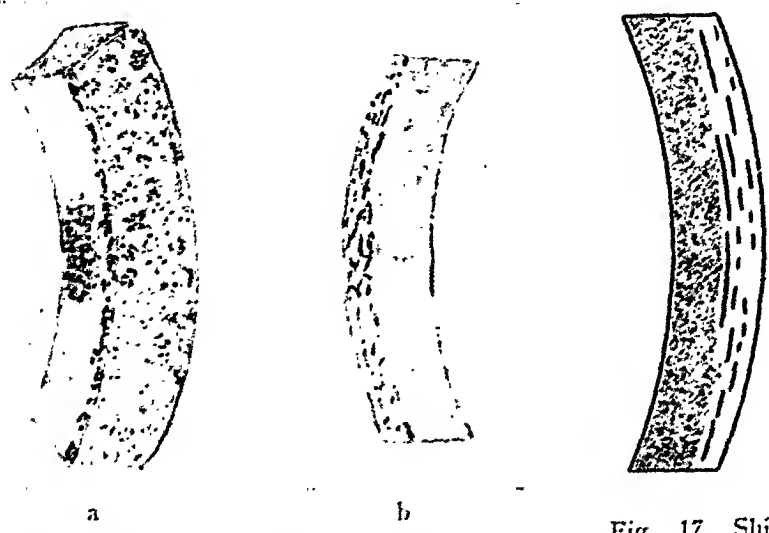


Fig. 16. The mildest Group-3 case. Appearance of dappling and endothelial change seen in a, the broad beam, and b, the narrow beam of the slitlamp, 23 years after the injury.

Fig. 17. Shiny dots and lines in the substantia propria many years after exposure.

that the experimental lesion in rabbits produced by droplets is comparable to the effect of fairly severe exposure to vapor in man.

The majority of these pathologic changes may be induced by agents other than mustard gas. The most characteristic signs are the blood islands and the peculiar varicosities seen after subsidence of the acute stage, also the ulceration of the superficial cholesterol deposits in the absence of fat. So far these signs have not been induced in rabbits by any other means, nor observed in man in conditions other than mustard-gas keratitis. The diagnosis rests on a combination of the nonspecific lesions with the typical vascular and degenerative changes in a definite time relationship and at a definite anatomical site. The lesions in man are described in the next section.

In conclusion we wish to thank Air Commodore P. C. Livingston, Flight Lieutenant H. M. Walker, and Messrs. Glaxo for their collaboration in handing over to us their collection of rabbits for a study of the late lesion in their series as well as our own.

## PART II

### STUDY OF THE CLINICAL PATHOLOGY OF MUSTARD-GAS INJURIES TO THE EYES IN MAN AND ITS CORRELATION WITH THAT SEEN IN RABBITS

IDA MANN, F.R.C.S.

A sufficient number of cases of mustard-gas injuries to the eye in man were available for the correlation of the changes with those in the rabbit. Allowing for slight anatomic differences which modify the appearance somewhat in rabbits, the similarity is remarkably close.

I am deeply indebted to Drs. MacLaren-Ferrie and Chiesman for their valuable help and close coöperation in collecting and observing the recent cases, to the late Mr. Bernard Chavasse for allowing me

access to his cases, and to Mr. T. J. Phillips for permission to use his cases and detailed unpublished work, on the late stages of the lesion, which has been necessary to complete the picture.

Although observations on the recent-accident cases are still continuing and certain gaps exist in the human series, it is possible to say that:

(1) The pathologic process is similar in man and the rabbit, the time relationships of the various stages being comparable, taking the accepted standard that a rabbit's life is one tenth that of a man and its reactions therefore 10 times as fast.

(2) The reaction (acquired sensitivity apart) in man as in the rabbit is dependent on the size of the dose and the anatomic situation.

(3) The explanation of the "late keratitis" seen in man up to 20 years after exposure has been attained by observation of the lesion in rabbits.

The human cases can be divided into five groups depending on the severity of the lesion.

#### GROUP I. EXTREMELY MILD CASES. CONJUNCTIVA ALONE AFFECTED

Ten cases fell into this group. The patients were examined at varying times after the accident from nine days to two years. Most of them were wearing either eye shields, chemical goggles, or respirator at the time of the accident, which in some cases was a direct splash, in others exposure to vapor. The amount of protection afforded even by the Army eye shield appears to be considerable.

Three of the patients were unaware that they had been exposed until the onset of symptoms. The usual history, however, was that the eyes became slightly bloodshot and the lids slightly swollen a few hours (usually not more than six hours) after known exposure. Complaint

was made of a feeling of irritation, but there was very little mention of photophobia, and the eyes were never closed. The feeling of soreness lasted usually four to seven days, but the patient did not stop working. In some cases the irritation was said to have lasted some weeks, but nothing could be seen to account for it.

In none of the cases examined in this group was there any corneal abnormality due to mustard gas.

The earliest case seen was at five days. The patient had also had an erythema of the neck which was still just visible. The eyes showed hyperemia of the conjunctivas but no hemorrhages nor anatomic disturbance of vessels. This was all that was ever seen in cases in this group.

Two of the cases are instructive. In both there was a history of a splash and in each case the eye was washed out very efficiently and copiously (in one for 20 minutes) within less than a minute. One patient used bicarbonate-of-soda lotion first and then tap water, the other tap water only. In one case the fingers of the man who washed out the eye were burnt as were the patient's lids. In both the lids were very swollen and the eye closed the next day, suggesting a severe lesion, but when the eyes could be opened, in four days, it was found that in both the cornea had escaped completely, although there was intense conjunctival hyperemia. On the thirteenth day, in one patient, the skin of the lids showed hard dry sloughs, but the eye was open and the cornea absolutely normal, in spite of the fact that the lower fornix and lower half of the ocular conjunctiva were intensely hyperemic, making it certain that some mustard (either vapor or liquid) had actually entered the eye. The other case had occurred two years previously and at present the cornea shows no scarring and there is no disturbance of the limbal blood vessels. In this case also the eyes were closed for four days

and the patient was off work for three weeks.

#### GROUP 2. MILD CASES. CONJUNCTIVA HYPEREMIC AND CORNEAL EPITHELIUM INJURED

Nine cases fell into this group. The earliest seen was three days after the injury, which was caused by vapor. The first thing noticed was a feeling of soreness in the eyes and throat on waking in the night nine hours after exposure. The left eye was slightly worse than the right. The voice was hoarse. The eyes could be opened but there was photophobia and lacrimation (which were still present at examination). The conjunctivas were hyperemic and the corneal epithelium in the palpebral aperture was edematous (epithelial bedewing), faintly gray, and slightly lazy. In the left eye a few minute punctate staining areas could be seen in the edematous area. (In one case this was still visible at nine days.) In the right eye a few fine, shining lines could be seen in the center of Descemet's endothelium and the outer side of the iris was hyperemic. This seemed to show that there was some penetration deep to the epithelium, but there was no edema of the substantia propria and the condition cleared up completely in both eyes. Three months later both corneas were normal, with slight conjunctival hyperemia. The triangular white patches of conjunctiva often described at the limbus are not seen in either group 1 or 2. They occur only in more severe lesions. The lesion in this patient resembles very mild epithelial damage in the rabbit.

The epithelial bedewing subsides, but before complete restoration to normal there is a stage at which a linear group of isolated shining dots (single hydropic epithelial cells) can be seen with the slit-lamp in the line of the palpebral aperture. In mild cases this is all that may be seen



by the fourth day. In slightly more severe cases they may remain visible for from four to six weeks. These may be present even in patients who have not made much complaint. In one case in which the eyes were completely closed for one day the patient was able to return to work in 48 hours (though the lids were sore for three days more), but hydropic cells were present in fairly large numbers for three weeks and could just be detected for six weeks.

One patient in this group was unable to open the eyes for four to five days, one for one day, while the rest stated that though the lids were swollen the eyes could just be opened.

### GROUP 3. SEVERE CASES. CORNEAL EPI- THELIUM AND SUBSTANTIA PROPRIA EDEMATOUS. INVOLVEMENT OF CON- JUNCTIVAL VESSELS, ESPECIALLY THE LIMBAL SUPPLY

Four cases fell into this group, of varying degrees of severity. In these cases and in those of group 4 we begin to be able to draw a definite parallel between the lesion in man and in rabbits, since in none of the rabbits was the lesion slight enough to produce group-1 alone and seldom group-2 changes.

The first patient had had fairly severe exposure to vapor in the laboratory, having worked unprotected in it for some hours as he had a cold and could not smell it. He noticed irritation that night and by 7:30 a.m. was sure he had been burned. He was admitted to the hospital by 2:00 p.m. in very acute pain, with the lids swollen, eyes closed, chest affected, hoarse voice, and burns on hands and arms. Phenolaine was dropped into the eyes with no effect. He was then given atropine and cocaine and experienced considerable relief. The lower parts of both corneas were hazy and swollen. There was definite edema of the substantia propria. In

the left eye there were subconjunctival hemorrhages at the limbus below and an avascular white necrotic patch in the conjunctiva near the limbus somewhat like the triangular white areas at the limbus described in acute cases in the last war. This condition was still present at the end of a week, when I saw him first, but the edema (primary edema) of the substantia propria was subsiding fairly rapidly.

The second case was similar and not so severe, although the chest was also affected. I did not see the patient till three weeks after the accident, when the right eye showed epithelial bedewing only. The left eye (frontispiece, 1) showed a small patch of hyperemia on the palpebral conjunctiva of the upper lid, a slight corneal haze in the palpebral aperture, and at the inner canthus a pale triangular area in the limbal conjunctiva. Three months later the corneas were normal, the granulating area on the lid showed as a healed but intensely red spot, and in the pale area against the limbus the limbal loops were absent and the vessels beside it slightly hyperemic. There were no symptoms.

The third case was seen 18 months after the injury. There were no symptoms. The corneas were normal, but in both eyes there were faint, pale, triangular areas at the limbus (their apices pointing to the inner and outer canthi) in which the limbal capillaries were absent and their place taken by a sparse and irregular arrangement of larger vessels. This appearance is sometimes called "marbling."

The fourth case, which was first seen a week after the injury, has been watched for over three months and promises to be the most severe and also the most instructive, since the period for which we have no accurate records even from the last war is that from three or four months to five or six years after injury.

This man was opening a cock and got

a spray of liquid mustard over his face. He was wearing celluloid eye shields. He received first-aid treatment within 10 minutes, consisting of washing his skin and eyes with bicarbonate-of-soda lotion (no copious irrigation of the eyes was given) immediately after which liquid paraffin was dropped into the eyes. In five hours the eyes and lids began to burn. Three hours after this, at eight hours, he was admitted to the hospital, with both lids extremely swollen and the eyes quite closed. The conjunctivas were edematous and the left was even then obviously worse than the right. In three days the lids could just be opened, but the sight was misty in both eyes, according to the patient. There was no blistering of the lids and no purulent discharge, only clear tears. Cocaine, 2-percent, was given whenever pain became excessive and gave great relief. It did not appear to have any harmful action. The right eye improved more quickly than the left.

I saw the patient *on the eighth day*.

*The right eye* was open, although the lids were swollen and the conjunctiva hyperemic. There was no stain. There was diffuse epithelial bedewing across the lower part of the cornea, with scattered minute white dots, probably single, hydropic, epithelial cells. The limbal blood vessels were engorged, especially below. The endothelium was normal. This lesion belongs to group 2, and when seen at three weeks was still hyperemic. At six weeks it was completely normal again.

*The left eye* on the eighth day was extremely hyperemic and the conjunctiva in the palpebral aperture and also to a slighter extent in the fornices was edematous, gelatinous looking, and slightly raised up, so that it formed a rim round the cornea, which appeared depressed below its level. The vessels were violently congested and toward the outer canthus showed some irregularity of caliber. There was punc-

tate staining of the cornea, which was grayish and hazy especially in its central and lower part, presenting the characteristic *peau d'orange* appearance of the early severe lesion in man. The corneal epithelium was edematous, the underlying substantia propria showed an altered, more shiny, and brighter zone in its anterior one third (early edema), with endothelial disturbance and ruckling of Descemet's membrane (fig. 12, Plate 8). As the iris was brown, hyperemia could not be made out. At the limbus, on either side, in the palpebral aperture were several somewhat circular opaque whitish patches, looking a little like small ulcers or sloughs but not staining with fluorescein. They occupied the position of the triangular patches usually described but were different in shape and extended on to the cornea. They probably correspond to the pale area at the limbus in the sector of application in the rabbit experiment. Their appearance thus suggested those seen in rabbits, with a lesion involving corneoscleral junction and lids, at 24 hours. This is to be expected if 10 days for a man is roughly equivalent to one day for a rabbit.

I next saw the patient at three weeks. He was unable to work. The right eye had recovered except for hyperemia, but he stated that the left had at first improved greatly (probably corresponding to the healing of the epithelium and subsidence of primary edema) and five days before had relapsed; he now wanted to keep it shut as there was a feeling of a foreign body all the time, especially under the upper lid.

The conjunctiva was not so swollen but conspicuous changes had occurred in it (Plate 9, fig. 2). The opaque areas in the limbal region were not present as areas of disturbance and partial destruction of the limbal capillaries. Above and below them were large subconjunctival hemor-

rhages and amongst these were many dilated vessels with thromboses.

The cornea was clearer but was covered with a very large number of minute whitish specks, probably closely set hydropic cells (many of them shiny and whiter than in the milder cases). In the lower part of the cornea there was edema of the substantia propria, with engorgement of the limbal blood vessels. With the slit-lamp it could be seen that the texture of the substantia propria was altered in its superficial layers (fig. 13, Plate 8). On evertting the upper lid an oval patch could be seen on the tarsal plate, white, opaque, with no visible blood vessels and resembling an infarct. A similar patch was present at the limbus on the inner side. Both were surrounded by engorged vessels. They were similar to conjunctival and lid lesions in rabbits.

I next saw the patient at five-and-a-half weeks. He was unable to work and still had the feeling of a foreign body under the upper lid in the region of the necrotic patch, which remained dead white. The white patch on the ocular conjunctiva was surrounded by hemorrhages and extended on to the palpebral conjunctiva below (Plate 9, fig. 3). The cornea was much clearer. The edema of the substantia propria had subsided, although there was still bedewing of the epithelium. The stroma showed an altered texture, best described as a faint dappling, in its superficial layers (figs. 14 and 15, Plate 8).

This eye appears to be in the condition of a rabbit at four to five days, when the primary edema is subsiding, the thromboses and hemorrhages are still present at the limbus, no vessels having yet grown in, and the eye is rapidly becoming quiet. The dappled appearance in man seems to correspond with the silky change in rabbits. The difference is probably due to anatomic differences in arrangement of cells and fibrils.

At eight weeks the patient was back at work, and felt much better. The white patch under the upper lid was smaller and was partially vascularized. Although the man complained of very little, the eye appeared rather worse. Intense engorgement of the ocular conjunctiva was manifest around and in the previously seen white patch below and also to the inner side. There was a reappearance of the corneal edema below and the limbal blood vessels on either side of the necrotic area were beginning to invade the cornea. There were thromboses at their growing tips and intracorneal hemorrhages in the superficial layers of the substantia propria (Plate 9, fig. 4). The secondary edema and vascularization were beginning, and the condition corresponded to that in the rabbit at five to seven days. The patient was next seen seven months after the injury. He stated that he had recovered and worked until two weeks previously. At that time the feeling of a "lump under the lid" returned. He was off work. He showed minute hemorrhages around the necrotic patch under the upper lid. The necrotic patch was completely revascularized and contained globules suggestive of fat. There was also some granulation tissue around it. The cornea was still bedewed, and in the area of limbal involvement there were some new hemorrhages from the extending capillary loops in the cornea and also deep in the conjunctiva (Plate 9, fig. 4). This case therefore would appear to be in the stage of recurrent hemorrhages and probable thrombosis which begins in the rabbit after the first month. This history brings out very well the extreme slowness of the changes in man and the likelihood of mistaking a clinical cure for a true cure since a good deal of the process in the more serious lesions is practically symptomless.

Cases such as this in which vascularization and secondary edema occur may sub-

side and give rise to no further symptoms (cf. the subsidence in rabbits after one to four months). Three such cases from the last war were examined and although the men considered that their eyes had recovered completely they all showed typical changes.

The one with the mildest case seen was gassed in 1917 and recovered after six months. One eye remained symptomless, but the other has had severe ulceration following an injury with sand in 1934. The uninjured eye showed destruction of limbal loops and a few varicosities of the conjunctival vessels in the palpebral aperture. The cornea showed epithelial bedewing, a faint dappling in the superficial layers of the substantia propria, and a disturbance of the endothelium (figs. 16a and b, Plate 8).

Two other cases of greater severity but also symptomless were seen. They both showed destruction of limbal capillaries in the white triangular area, varicosities of conjunctival vessels, epithelial bedewing, shiny dots and lines in the substantia propria (fig. 17, Plate 8), and also a peculiar appearance, not often seen in rabbits. This is usually referred to clinically as "black lines" or "tubes." It is an appearance of branching clefts or spaces running through the substantia propria at all depths and more or less perpendicular to the surface. It does not alter the transparency of the cornea but definitely indicates a deep penetration by mustard gas in the past. It affects only the part of the cornea exposed and not necessarily all of that. It is not present in every case and it is probable that more than one kind of "black line" exists, determined by the anatomic basis and position of the change. Further work is needed on this point. It is not diagnostic but may occur in other degenerations. These cases correspond to the healed rabbits with silkiness and the remains of vessels of peculiar shape; examined at nine months.

#### GROUP 4. VERY SEVERE CASES SHOWING LATE SECONDARY ULCERATION (SO-CALLED DELAYED KERATITIS)

Since we know that the lesion in rabbits continues to show changes for at least nine months or a year and that in the severe cases secondary ulceration (from cholesterin deposition and fatty degeneration or persistent edema) may begin in eight to nine months, we should expect to find ulceration in man in about 8 to 10 years when the slow degenerative changes will have reached the requisite stage. The interim period is symptomless, since there is no loss of epithelium and the changes are confined to the substantia propria of the scarred areas. There is decreasing vascularization as the vessels recede, leaving behind them the deposit of cholesterin, so that clinically the eye appears to be getting better all the time. A study has been made of 39 cases and case histories of patients at present attending Moorfields Eye Hospital or the Ministry of Pensions for delayed war-gas keratitis, and this, together with Mr. T. J. Phillips's examination of 70 cases and my own observations on the course of the recurrent attacks, completes the picture. Plate 9, figures 5 and 6, shows a typical case.

#### TYPICAL CASE OF DELAYED KERATITIS

A patient, aged 50 years, was examined. He gave a history of exposure to gas from a gas-shell barrage in July, 1917. He put on his gas mask, left the lorry he was driving, and went into a dugout for some hours. He was in the hospital in France for a month and in England for six months, during the whole of which time his eyes were kept bandaged. He had burns on the face, and his chest was affected. His eyes gradually recovered except for slight dislike of strong light, but his chest has given trouble ever since.

In 1927 he attended an eye hospital for corneal ulceration, especially in the right eye. The individual ulcers healed quickly.

often in a few days, but the irregularity of the surface of the cornea increased after each attack (cf. depressed area in rabbit's eye where cholesterol has been cast off, fig. 9, Plate 7), as there seems to be actual loss of substance when the degenerated area ulcerates. His sight, therefore, steadily deteriorated, and in 1931 he was awarded a pension for his eyes. The recurrent ulceration continued, and this year he was seen by Mr. Phillips and fitted with Dallos contact lenses. His visual acuity is R.E. 6/36, L.E. 6/9 not improved by spectacles. With contact lenses, which are well tolerated, his vision is improved to R.E. 6/6 partly, L.E. 6/5, and so far he has had no recurrence of ulceration. He shows in the right eye (which has had most ulcers) cholesterol crystals, fatty degeneration, silkiness (seen partly as dappling and partly as fine short lines, slightly different in texture from that in the rabbit, and probably depending on the slightly different shape and size of the cells and fibers in man), and irregular vessels in process of disappearing together with deposition of cholesterol (cf. rabbit, eight months or more). In the left eye there is less cholesterol, gray and black lines, and alteration of the substantia propria.

The astonishing improvement in visual acuity with contact lenses which he shows is seen in all cases and is due to the substitution of the smooth glass for the irregular and uneven corneal surface as the main refracting interface. The good tolerance of all delayed gas-keratitis cases for individually fitted contact lenses is associated with a certain amount of corneal anesthesia from previous destruction of nerve fibers and the effect of the lenses in preventing recurrent ulceration is probably explained by the protection of the partially insensitive cornea from multiple minute injuries. The same beneficial effect is seen from a tarsorrhaphy, but the contact lens has these great advan-

tages, that it is permanent, transparent, and improves visual acuity.

All the cases of delayed ulceration (which should not, in my opinion, be called keratitis as it is not an inflammation but a degenerative ulceration) show these changes. The typical picture is of an eye in which the upper part of the cornea and the limbal loops are normal (fig. 18, Plate 10\*). Across the center and lower part runs a band of opacity stretching between the white areas on the conjunctiva in which the limbal loops are absent and the few vessels there are, are badly formed. The scar shows great irregularity of surface. At its edges and in its base are cholesterol crystals. It is vascularized by peculiarly contorted and varicose vessels which enter through the normal limbus above and below the worst scars (figs. 19A and B, Plate 10). There may be narrow constrictions, blood islands, intracorneal hemorrhages, and thromboses. The scar shows, in addition to the cholesterol, white flocculent masses of fatty degeneration, patches of a fibrillar silky texture, and black and gray lines of a peculiar distribution. All these changes, except the black lines, have been reproduced in rabbits. The pathology, therefore, appears as a slow degenerative process. It is initiated by direct chemical action which produces injury and intense edema. These two factors combined allow invasion of the cornea by newly formed blood vessels that are extremely abnormal in form. They are derived from both normal and injured conjunctival vessels. As the corneal vessels slowly retrogress in the course of years, blood may be left in the substantia propria. Vascular regression is followed by cholesterol and fatty degeneration which are responsible, alone or combined, for the "delayed keratitis" (see table 2). Although there is said to be a completely quiescent interval of 6 to 16 years, the eyes show definite diagnostic

\* See reverse side of frontispiece.

signs the whole time, and are merely symptomless.

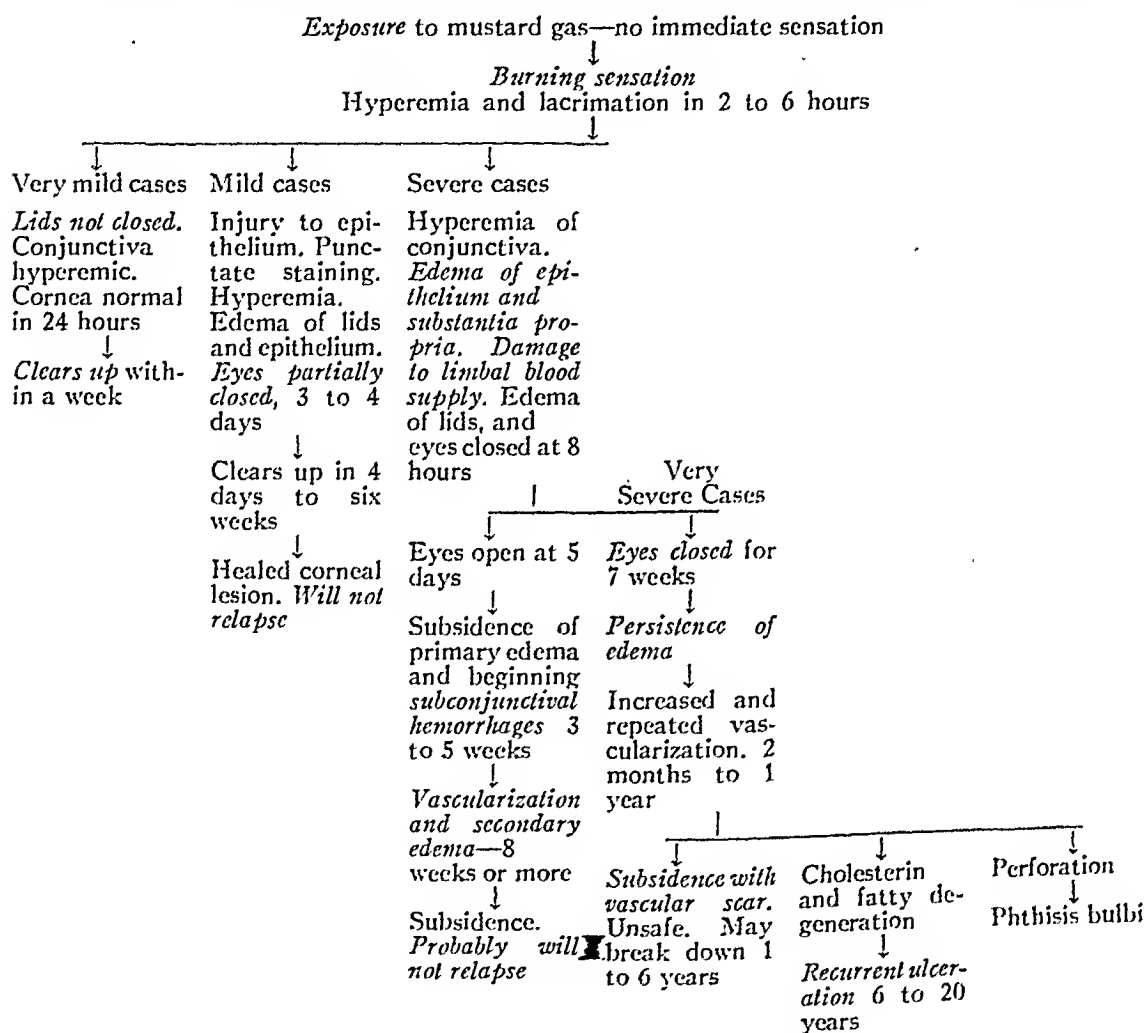
GROUP 5. EXTREMELY SEVERE CASES  
SHOWING CORNEAL PERFORATION

These cases are very rare in man. I

burning sensation for a short time but could open his eyes at once and could see for about 10 hours afterward. Intense discomfort and much swelling of the lids then came on, and he was unable to open his eyes for 10 weeks. When the lids

TABLE 2

COURSE OF MUSTARD-GAS LESIONS IN MAN, COMPILED FROM OBSERVATIONS ON 65 CASES



have seen only one that is undoubted and have heard of two others. The patient I examined is now 55 years of age. He stated that he was in a "pill box" in 1917 and a gas shell entered it and exploded within 6 feet of him, splashing him with the contained liquid mustard. He felt a splash in his face and eyes. He had a

opened he could at first see practically nothing, but in the following nine months his sight improved so that he was able to read with glasses. He worked as a gardener but had frequent attacks of discomfort and burning. For the last 15 years he has had severe attacks of ulceration and a perforation occurred in the left eye.

At the present time the right eye shows a typical cholesterin scarring that is more severe than usual as the whole cornea is involved and not only the exposed portion. The left eye, however, shows a perforation that has healed with inclusion of iris. This is above the center of the pupil, is small, almost circular, and resembles those seen in rabbits except that it has healed, while in the rabbits complete phthisis bulbi usually resulted. The whole of the rest of the cornea is scarred, vascular, and irregular. This patient cannot tolerate contact lenses although they improve his visual acuity from counting fingers to 5/60 in his better eye.

This case completes the series and corresponds with the rabbits in group 3. It is probable that only a direct splash in man would cause perforation, although, as has been seen, prolonged exposure to vapor will produce nearly as severe a lesion, the difference between the effects of vapor and the effects of a splash of liquid being merely one of degree and situation. It is thus apparent that the difference between the effects of vapor and the effects of a splash of liquid mustard gas is merely one of degree and situation.

All stages linking the two have been seen and of the severe but symptomless cases described in group 3 (page 1271) one was due to prolonged exposure to vapor in France in the last war and the other to a splash in a laboratory. Today it is not possible to say which lesion is due to the splash and which to vapor. The vapor burn is, if anything, the worse of the two.

Twenty of the patients with very severe cases from the last war were questioned as to circumstances and length of time in hospital. Fifteen out of 20 were confined in an enclosed space for some hours in vapor (dugout, trench, cellar, and so

forth); 8 stated that it was not raining at the time, and some gave their opinion that gas was not troublesome during rain. Three were not wearing a gas mask. One wore it all the time but was several hours in vapor. Ten only wore the mask part of the time. All of them were seriously ill, vomited, and several were unconscious soon after. The average stay in the hospital was six months and the average time the eyes were closed was seven weeks. Many stated that their eyes were kept bandaged and this may have lengthened the time. It is probably better not to bandage.

#### CONCLUSIONS

1. The clinical pathology of the lesion involving the limbus is similar in man and the rabbit (see tables 1 and 2).

2. The reaction in man and the rabbit is dependent on the size of the dose and the anatomic situation. The effects of vapor and liquid are different only when the actual amount of mustard gas which soaks into the tissues is different; that is, the difference is quantitative only.

3. The late keratitis in man is seen as a degenerative ulceration depending on the initial damage sustained by the limbus and cornea, and not on any continued action of mustard gas or any of its breakdown products.

4. From 3 it follows that in the present state of our knowledge prophylaxis is likely to be much more important than treatment. It is very difficult to assess the value of treatment in man, since the dose of mustard gas received can never be known, and no two cases will be comparable. Two eyes of the same patient may be comparable although by no means always, even when the lesions are due to vapor.



# ORAL USE OF PROPHYLACTIC SULFADIAZINE FOR CATARACT EXTRACTIONS\*

JACK S. GUYTON, M.D., AND ALAN C. WOODS, M.D.

Sulfonamide therapy, both systemic and local, has been widely used as prophylaxis against infection following various traumatic injuries and before surgical procedures where a strictly aseptic operative field cannot be obtained. The value of such prophylactic sulfonamide therapy is well established. This present study was undertaken to determine if the systemic use of sulfadiazine immediately prior to cataract extraction and maintained for the first week subsequent to operation would be of value in controlling postoperative ocular infection. Prophylactic sulfadiazine was used in a test series of 312 extractions.

As controls to determine the incidence of infection following cataract extraction, two series of cases were available. The first series consisted of 159 extractions performed with a technique exactly similar to that employed in the test series. The second series consisted of 642 extractions performed in the Wilmer Institute between 1926 and 1938. In this series both the preoperative clean-up and the operative technique varied over those years, in the later years approaching the technique used in the test and first control series. A comparison of these series reflects the value of sulfadiazine in the prevention of postoperative infection.

## METHODS AND MATERIALS

### 1. PRE-OPERATIVE AND OPERATIVE TECHNIQUES

The preoperative preparation of eyes

\* From the Wilmer Ophthalmological Institute of the Johns Hopkins University and Hospital. Presented before the New York Academy of Medicine, Section of Ophthalmology, May 17, 1943.

in the sulfadiazine series and in the first control series was exactly the same. The night before the operation was to take place the lids were scrubbed with soap and water, the lashes were cut, and, after the instillation of 10 percent argyrol, the conjunctival sac was irrigated with boric acid. On the day of the operation each eye was irrigated several times at intervals of one to two hours. After the patient entered the operating room the lids were again scrubbed with soap and water, the eye was thoroughly irrigated a number of times with boric acid (after 10 percent argyrol had been instilled), the lid margins and lids were painted with tincture of metaphen 1:200, and the patient was draped with sterile towels and sheets. As nearly perfect as possible aseptic technique was used during the operation. In the sulfadiazine series and the first control series rubber gloves were always worn by the surgeon, the assistant, and the nurse. In the second control series, especially in the early days of the Wilmer Institute, rubber gloves were not always worn by the surgeon, although they were always worn by the assistant and the nurse.

All of the extractions in the sulfadiazine series and the first control series were performed with two corneoscleral sutures, of the type described by McLean,<sup>1</sup> and an average of five conjunctival sutures. In the second control series either no sutures or only conjunctival sutures were placed before extraction was performed. The types of extractions done in the test and two control series are shown in table 1.

The notable differences between the test and the first control series as com-



pared with the larger second control series lies especially in the operative technique. Between 1926 and 1931 the operation most frequently employed was a combined extracapsular extraction without a conjunctival flap and with no sutures. From 1931 to 1938 the most frequent operation was a combined intracapsular or extracapsular extraction with conjunctival flap and conjunctival sutures. Thereafter the employment of one, and then

## 2. ADMINISTRATION OF SULFADIAZINE

Each patient in the test group was given three grams of sulfadiazine the night before the operation and one gram three times a day for seven days thereafter, unless a toxic reaction made it necessary to discontinue the drug, or it seemed wiser to continue it for a longer period of time. This dosage produced an average free sulfadiazine level in the blood of 6.36 mg. percent, with a standard deviation of 3.01 mg. percent. The extremes of range of the blood level were 2.0 mg. percent and 22.0 mg. percent, respectively.

Sulfadiazine was not used prophylactically in any patient who had albumin in his urine or other evidence of decreased kidney function. Certain routine procedures were carried out to detect toxic reactions and to control administration of the drug:

1. Temperatures were taken every four hours day and night. Sulfadiazine was discontinued if the temperature became elevated above 100 degrees without any other obvious cause.

2. Sulfadiazine was stopped if any rash appeared or if the patient became appreciably nauseated.

3. Fluids were forced to 2,500 c.c. per day, fluid and urine charts were kept for each patient, and the urines were examined microscopically for red blood cells every two days. Sulfadiazine was discontinued if any red blood cells were found in the urine.

4. Blood sulfadiazine levels were determined on the second and fourth days of sulfadiazine therapy. The dosage was reduced if the free blood sulfadiazine level reached a level higher than 10 mg. percent.

5. White-blood-cell counts were taken on the second and fourth days of therapy. The drug was stopped if the white blood count dropped below 4,000.

It was necessary to discontinue sulfa-

TABLE 1

TYPES OF CATARACT EXTRACTIONS IN THE TEST AND TWO CONTROL SERIES

Type of Extraction	Sulfadiazine Series	First Control Series	Second Control Series*
Simple intracapsular	174	60	0
Combined intracapsular	76	68	177
Simple extracapsular	8	4	0
Combined extracapsular	54	27	465

\* A moderate number of extractions in this group were performed after preliminary iridectomy, but these extractions are classed as "combined."

two, corneoscleral sutures became routine procedure. All extractions in the sulfadiazine series were performed between October 1, 1941, and January 15, 1943. The extractions in the first control series were performed during the periods of June 1, 1941, to October 1, 1941, and January 15, 1943, to March 15, 1943.

In all three groups the eye that was operated upon was first dressed between the first and fourth postoperative days and thereafter the eye was usually irrigated with argyrol and boric acid once daily. The corneoscleral sutures were usually removed on about the twelfth postoperative day, and the conjunctival sutures either at this time or a few days earlier.

diazine because of toxic reactions in 24 of the patients. The toxic reactions encountered are listed in table 2. None of these reactions caused any serious trouble,

TABLE 2

TOXIC REACTIONS RESULTING FROM SULFADIAZINE IN THE TEST SERIES

Toxic reaction	No. of cases
Fever higher than 100°F.	11
Fever plus rash	3
Nausea	7
Leucopenia (WBC less than 4,000)	2
RBC in urine	1
Total	24

since the drug was stopped as soon as any toxic reaction appeared.

### RESULTS

The total combined incidence of postoperative reaction, including all undue inflammation indicative of actual or questionable infection, was as follows in the three series: 1. Sulfadiazine series—1.6 percent. 2. First control series—7.5 percent. 3. Second control series—9.7 percent.

The results with regard to postoperative endophthalmitis, uveitis, and stitch abscesses, divided as to intracapsular extractions, are shown in table 3.

The ratio of postoperative "uveitis" to postoperative "endophthalmitis" is much higher in the second control series than in the other two groups. This is probably because for the past several years postoperative inflammations have generally been classified as "endophthalmitis," rather than "uveitis," as they were classified in the earlier years of the second control series. Allowing for this difference in classification there is a significantly lower incidence of infection in the sulfadiazine series than in either of the control series. Since no corneoscleral sutures were used in the second control series, no infected corneoscleral sutures were encountered.

In the series of patients treated with sulfadiazine there was one case of purulent endophthalmitis which occurred on the fourteenth day, seven days after sulfadiazine had been stopped. This cleared completely when sulfadiazine was given

TABLE 3

INCIDENCE OF POSTOPERATIVE INFECTION AFTER CATARACT EXTRACTIONS CLASSIFIED ACCORDING TO INTRACAPSULAR AND EXTRACAPSULAR EXTRACTIONS

	Type of Extraction	Endophthalmitis percent	Infected Corneal Suture percent	P.O. Uveitis (Questionable Infection) percent	Total percent
Prophylactic sulfadiazine series (312 cases)	Intracapsular (250 cases)	0.0	0.4	0.8	1.2
	Extracapsular (62 cases)	1.6	0.0	1.6	3.2
First control series* (159 cases)	Intracapsular (128 cases)	3.1	3.9	0.0	7.0
	Extracapsular (31 cases)	6.4	0.0	3.2	9.6
Second control series* (642 cases)	Intracapsular (177 cases)	0.0	—	4.5	4.5
	Extracapsular (465 cases)	1.1	—	10.5	11.6

\* See text.

again, with 20/20 vision resulting. There were one case of minor staphylococcus stitch abscess which recovered uneventfully, and three cases of postoperative uveitis in which the rather prolonged postoperative inflammation appeared more likely to be related to operative complications (loss of vitreous in each instance) than to actual infection.

In the first control series there were six cases of postoperative endophthalmitis which developed between the fourth and tenth day after operation. All of these patients were promptly treated with either sulfadiazine or sulfathiazole. Final vision was limited to light perception in two instances, 1/200 in one instance, 20/70 in two cases, and was 20/20 in the remaining case. In five other patients there were localized staphylococcal infections around one or both corneoscleral sutures. In four cases, recovery was uneventful after removal of the sutures and institution of sulfadiazine therapy. In the remaining case early removal of the sutures was followed by rupture of the operative incision and further complications which eventually resulted in loss of useful vision. There was one case of persistent low-grade postoperative uveitis which necessitated enucleation of the eye three months later because of severe ocular pain. In this case vitreous was lost at operation, which may account for the postoperative inflammation. In the second control series there were five cases of purulent endophthalmitis, which resulted in complete loss of vision. There were 57 cases of so-called postoperative uveitis, with loss of vision in 17 and only 20/200 vision in 7 others.

#### COMMENT

These results speak for themselves and show quite clearly the beneficial effect of the routine use of sulfadiazine as prophylaxis for cataract extractions.

There are three valid objections to us-

ing sulfadiazine prophylactically for cataract extractions. First, if the patient develops a sensitivity to sulfadiazine as manifested by drug fever or rash, he will thereafter probably be unable to take sulfadiazine and may not be able to take any of the sulfanamides, should such be indicated at some later date. Second, sulfonamide therapy necessitates an appreciable increase in the postoperative care (temperature, blood, and urine) to detect toxic reactions before they become serious. Third, the present cost of sulfadiazine required for prophylactic administration in the dosage used in this test series amounts to approximately \$3.00 per individual.

In the light of these objections it seemed possible that the local use of sulfadiazine in the eyes might give an equally protective effect and so avoid the difficulties incident to its systemic use. This was further suggested by the excellent results obtained in the treatment of wounds and compound fractures with local sulfonamide prophylaxis. We therefore used sulfadiazine powder in the conjunctival sacs of about 20 patients at the end of cataract operations. However, in this small group of extractions one endophthalmitis and one stitch abscess developed, and the powdered sulfadiazine appeared to irritate the eyes that had just been operated on. Such local prophylaxis was therefore abandoned.

Despite the objections which may be raised to the systemic use of prophylactic sulfadiazine in cataract extractions, the beneficial results obtained appear to outweigh by far the disadvantages, and we believe such use of sulfadiazine is a thoroughly justifiable and worthwhile procedure. Possibly it would be better to administer sulfadiazine only four days following cataract extraction, since a drug fever or rash rarely develops during this time. It is probable that some other sul-

fonamide or some other antibacterial agent similar to penicillin may be found which will prevent ocular infections without the occurrence of occasional toxic reactions.

### SUMMARY AND CONCLUSIONS

The value of systemic administration of sulfadiazine as prophylaxis against

postoperative infection was investigated in a test series of 312 cataract extractions. The incidence of postoperative infection was significantly lower than in two control series of 159 and 642 extractions, respectively. We believe the beneficial results obtained outweigh the minor disadvantages of giving small doses of sulfadiazine systemically.

### REFERENCE

- <sup>1</sup> McLean, J. M. A new corneoscleral suture. *Arch. of Ophth.*, 1949, v. 23, pp. 554-559.

## IS GLAUCOMA A DEFICIENCY DISEASE? IMPORTANT DETAILS CONCERNING THE NONSURGICAL TREATMENT OF GLAUCOMA SIMPLEX\*

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It has been universally conceded that the fine and occasionally spectacular results obtained by ophthalmologists are due, among other things, to the tradition of paying the utmost attention to the minutest details in each step of surgical procedures. One could not sing the same praise of our profession when we consider our methods of treating nonsurgical eye diseases. Glaucoma is perhaps the most patent illustration of this state of affairs. Textbooks on ophthalmology and even elaborate monographs give the subject of pharmacologic treatment of glaucoma simplex only a casual nod, as if it has a humble role in the scheme of life and does not deserve special attention.

The purpose of this contribution is to present a few thoughts on the nonsurgical therapy of glaucoma simplex, derived purely from personal clinical experience.

\* Lecture delivered on March 26, 1943 before the combined graduate staffs of the Manhattan Eye and Ear and the New York Eye and Ear Hospitals.

The paper is a continuation of the ideas expressed in an article published in *The British Journal of Ophthalmology* (1938, pp. 418-425) under the title, "New developments in the pharmacological treatment of primary glaucoma."

### I. TREATMENT ACCORDING TO GENERAL PRINCIPLES, CLASSIFICATION OF STAGES OF GLAUCOMA, TYPES, AND AGE GROUPS

The guiding principles for the treatment of patients suffering from glaucoma simplex, are:

1. To promote the general health of the patient.
2. To eliminate or alleviate as much as possible any factors or circumstances which break down the patient's vitality.
3. To keep in mind the following points: (a) the stage of glaucoma; (b) the type of glaucoma; (c) the age of the patient; (d) the type of patient.

Careful consideration of these pre-

liminaries is essential for a rational treatment of glaucoma patients.

#### STAGES OF GLAUCOMA

There are four principal stages of glaucoma.

First, the *initial stage*, in which the disturbances are purely functional and transitory. These disturbances may be kept under control by avoiding unfavorable circumstances; they may even disappear spontaneously or respond readily to mild and infrequent medication. The condition is reversible, just like vasomotor-allergic disturbances, fatigue, and some intoxications, which disappear as soon as the causative factors cease to act. In this stage no organic lesions are discoverable by our present methods of examination. *There are symptoms, but no signs present.* Ocular hypertension may be a rare occurrence. This stage is readily overlooked. The first stage may last months or even years.

The *second stage*, in which functional disturbances predominate but organic changes begin to make their appearance. The central visual function is still maintainable, by treatment, at a fairly normal level. Symptoms recur more frequently; the signs are barely discoverable.

The *third stage*, in which the disturbances are predominantly of organic nature. The visual function fails progressively, and the ocular hypertension is controlled with difficulty. The signs are easily discernible, tonometric findings and provocative tests are characteristic.

The *fourth* is the *terminal stage*, in which visual failure and degenerative changes are the main feature.

The duration and course of each stage depend on the type of glaucoma, type and age of the patient, and his general condition.

It is obvious that the local treatment of a glaucoma patient must depend on the

stage in which his glaucoma happens to be.

#### TYPES OF SIMPLE GLAUCOMA

From the clinical point of view, the types of simple glaucoma may be classified as:

Type 1 (*benign*), in which symptoms appear at rare intervals and disappear spontaneously without leaving behind any appreciable permanent damage—such cases may remain in the first stage for many years.

Type 2 (*hypertensive*), in which the increase of tension and its sequelae dominate the clinical picture.

Type 3 (*optic-degenerative*), in which the gradual loss in the field of vision is the main feature and indicates a progressive optic atrophy. This type may remain "silent" and leave the patient ignorant of his ocular condition for a long time.

Type 4 (*mixed type*), in which types 2 and 3 are combined, in varying degrees.

Type 5 (*malignant*), in which a moderate degree of ocular hypertension, though present and frequently quite high, remains more or less "silent" for a considerable length of time. In this type the eye reacts to surgical intervention in an acute and malignant manner (allergy to surgical trauma?). Such cases are rare but very worrisome.

#### THE AGE OF THE PATIENT

The age factor is important in determining the form of treatment. From this point of view glaucoma patients can be classified in the following age groups:

1. The *pre-presbyopic* group, frequently familial.
2. The *middle-age* group, between 40 and 55 years, when the aging processes throughout the entire organism (especially the upheaval caused by the climacterium) play a leading role.
3. The *presenile-age* group, between 50 and 70 years, in which metabolic and nutritional

disturbances and the sequelae of infections of long standing are apt to be an additional burden to the glaucoma problem. 4. *Old age*, beginning as early as 45 or as late as 80 years, in which degenerative processes of the lenses, the vascular system, and of the optic nerves are as important, or even more important, a problem than the ocular hypertension.

Each of these age groups has its own medical peculiarities and difficulties. In some, the control of ocular hypertension constitutes the main problem, therefore miotics or operations are the known answer. In others, the progressive optic atrophy or rapid degeneration of some parts of the uvea and the lens requires attention; miotics may be useless or even disturbing in some of these cases.

#### TYPE OF PATIENTS

This also plays a role in determining the course, prognosis, and treatment of glaucoma simplex. The placid, calm, inert type in whose life fear and worry play a minor role is much less of a therapeutic problem than is the alert, emotional, over-anxious patient. A knowledge of applied psychology is of great benefit in treating the latter type.

#### THE PHARMACOLOGIC TREATMENT OF GLAUCOMA SIMPLEX

Before proceeding with the discussion of this subject, it may be appropriate to point out a prevailing error of major importance; namely, many are prone to think that "ocular hypertension is glaucoma and glaucoma is ocular hypertension." But this is not true in any case. There are many cases of glaucoma in which the degenerative process of the optic nerve, uvea, and lens continues to progress in spite of a successful medical or surgical reduction of the ocular hypertension. No doubt there are factors other than hypertension that are involved in

causing the entity called glaucoma; perhaps one of the most important of these is the one that brings about hypertension. Why limit our efforts to the treatment of ocular hypertension instead of looking for the "culprits" higher up? However, the ophthalmologist's entire armamentarium against glaucoma consists of drugs and operations which, under certain circumstances, are effective only in reducing ocular hypertension and its sequelae.

In prescribing the well-known drugs (pilocarpine, eserine, acetylcholine, and their chemical derivatives) it is necessary to determine:

1. The *frequency* and timing of instillations.
2. The *dosage* which, obviously, is not to be the same in benign as in malignant, in incipient as in more advanced cases, in very old as in young individuals.
3. The *combination* of two or three drugs, which when used in one prescription or separately at different times of the same day or week, should be based on reason and clinical experience and not only on guesswork.
4. The *indications* for prescribing one miotic in preference to another.

In connection with the subject of frequency of instillations and dosage of solutions, the following point deserves special attention. I have found that a planned variation in frequency and dosage has, at times, a certain advantage over a too-rigid formula. Patients are usually told to use the same formula for years (1 drop thrice daily). But eyes in some suitable cases do much better when the drops are instilled three or more times the first day, twice the second day, only once the third day, and no drops the fourth day. Furthermore, the lowering of the dosage to 0.5 percent and raising it alternately to 2 to 3 percent, and vice versa, give at times better results than the continuous use of the same dose, day in and day out.

The frequency of the instillations and

dosage are best determined by the *tonometry test*. This test is performed in the following manner: The tonometric measurement is repeated a number of times, at regular intervals, during a period of two to four weeks. The patient is instructed to stop using the miotic for a longer period each consecutive time. If, for instance, on the first examination the interval between instillation and tonometry has been 2 hours, at the second examination (the following day) the interval should be 4 hours; at the third examination, 8 hours, and so on up to 24 or 48 hours, if necessary. At some point along this sequence of tests there will be found a time when the *least* frequent instillation gives results (tonometrically speaking) as good as the preceding more frequent one. This constitutes the *approximate optimum of frequency*. It is often useless to try instillations less often, if the more frequent ones fail to reduce the ocular hypertension.

The same principle of the tonometry test is applicable also to the method of working out *the formula for the dosage*. In the beginning tonometric control of the result of using a certain dose is established, and from this point one may work his way toward a stronger or weaker dose, according to the subsequent tonometric findings.

These considerations should make it clear why it is important to enter always on the record, together with the tonometric measurements, the dosage and the number of hours that have elapsed since the last instillation of drops.

The correct "*timing*" of instillations is important. In some cases the rise of tension does not occur at the exact period of the day or night as predicted by the well-known glaucoma tension curve. Patients who spend hours in darkness and excitement while at movies and theaters, who are rushed and worried for a good part of the morning or afternoon in busi-

ness or during the performance of professional duties, are apt to develop an ocular hypertension at any hour of day or night, according to the special circumstances and not always according to the curves mentioned in textbooks. Therefore, the traditional instruction, "use the drops three times daily," without mentioning when, does not take into consideration the need for proper *timing*. It is for the special circumstances to dictate, whenever practical, which hours of the day the drops are to be used. Some patients even volunteer the information that at a certain definite hour "I feel the need of using the drops," or, "I found that I must use the drops before and after the movies," and so on. However, this does not mean that the matter of frequency and timing should be left entirely to the patient's discretion.

#### REMARKS ON INDICATIONS FOR AND MODE OF ACTION OF PILOCARPINE, ACETYLCHOLINE, MECHOLYL, DORYL, ESERINE, AND PROSTIGMIN

So far, the preference for any of these drugs has been a matter of guesswork and intuition. Proper indications for their use are not being discussed in books or current ophthalmologic literature. It should, therefore, be pardonable if an attempt is made in this paper to formulate some general principles concerning indications. Since the conception of the ideas herein expressed is based upon the theory of chemical mediation of nerve impulses, it may be advisable to refresh one's knowledge of this theory.

For a long time physiologists have been wondering how impulses traveling along nerves are transmitted from the nerve terminals to secretory or muscle cells (effector cells) and by virtue of what device the nerve impulse brings about the activity of a secretory or muscle cell. The beginning of an answer was

given by Elliot in 1905.\* He observed that a smooth muscle which contracts, when the corresponding sympathetic nerve is stimulated, will also act after the complete degeneration of the nerve (artificially induced by extirpation or section), if epinephrine is applied to that muscle. Since the epinephrine could not act on the degenerated nerve terminals, it follows that its action was limited only to the muscle cells. Elliot concluded that impulses traveling along sympathetic nerves do not act directly upon the smooth-muscle cells by "jumping" the neuromuscular partition. He assumed that on the arrival of the impulse at the nerve terminals an epinephrinelike substance, sympathin (Sy), is "secreted" or "liberated" and that this chemical substance acts as the stimulus, bringing about the function of the muscle cells. *This chemical substance is the chemical mediator of the sympathetic nerve impulses.* Since 1905 a large number and a great variety of experiments have been performed by physiologists and pharmacologists, and Elliot's experiments and conclusions were confirmed. The study of the transmission of nerve impulses to motile and secretory cells has been extended to the two components of the autonomic nervous system (the sympathetic and parasympathetic.) Thus, the fundamental discovery was rounded out: *Nerve impulses are transmitted to the secretory or contractile cells (effector cells) by the aid of a chemical mediator.*

Generally speaking, chemical mediation takes place throughout the entire organism wherever there are tissues (reached by nerve impulses) charged with the function of motility and secretion.

*There are evidences that lead us to believe that in glaucoma, there exists a*

*disturbance of the processes of chemical mediation of nerve impulses at the neuro-effector junction.*

Before proceeding further a definition of the following two terms is in order: *Neuro-effector unit* is the mechanism that maintains the intraocular pressure at a certain stabilized level throughout the entire lifetime. It consists of the uvea (including its musculature, vascular, and nervous systems), the drainage system of the eyeball, the lens, sclera, extrinsic muscles of the eye, branches of the trigeminus, and probably many other constituent parts yet unknown.

*The Neuro-effector junction* is the location at which the sympathetic and parasympathetic nerve terminals meet the constituent parts of the Effector portion.

The physico-chemical phenomena taking place at the neuro-effector junction could be summarily expressed in the following statements:

1. Impulses reaching the parasympathetic-nerve terminals stimulate the formation of an acetylcholinelike substance (A-C), which acts upon the corresponding motile or secretory cells (effector cells).

2. Nerve impulses reaching the sympathetic-nerve terminals release an epinephrinelike substance called sympathin (Sy) which mediates the action of the impulse upon the corresponding effector cells.

3. The source of the chemical substance present at the neuro-effector junction from which the nerve impulse creates A-C is dependent for its maintenance on the integrity of the nerve endings. This source disappears or becomes depleted when the nerve fibers begin to degenerate.

4. A-C is destroyed by an enzyme (esterase) very soon after it has been produced. It is only during a short time (measured in thousandths of a second) before it is neutralized that A-C acts upon

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\* Elliot, T. R. The action of adrenalin. Jour. of Physiol., 1905, v. 32, pp. 401-467.



the effector cells. The process is repeated rhythmically as long as the nerve impulses arrive.

5. Eserine has the property of inhibiting the neutralizing effect of esterase upon

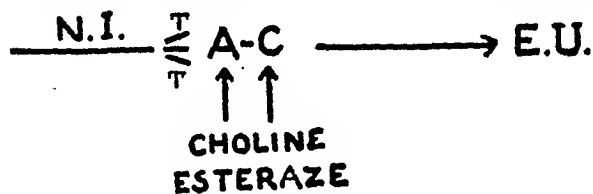


Fig. 1 (Schoenberg). The nerve impulse (N.I.) reaching the nerve terminals (T-T) liberates acetylcholine (A-C) which is partly neutralized by choline esterase. Part of A-C reaches and stimulates the effector unit (E.U.).

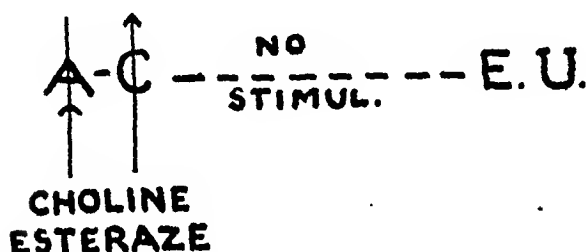


Fig. 2 (Schoenberg). If A-C is entirely neutralized by choline esterase, the effector unit (E.U.) is not stimulated and remains inert.

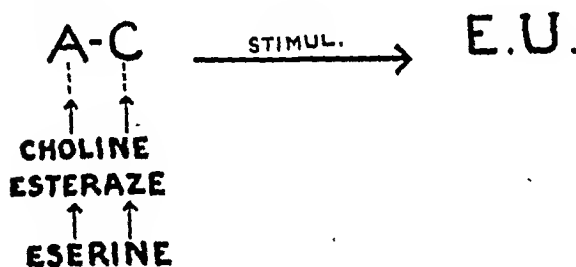


Fig. 3 (Schoenberg). If eserine is used (in a case such as in fig. 2), it will inhibit the neutralizing action of choline esterase and A-C is free to stimulate the effector unit. Eserine has no direct action upon the effector unit (E.U.).

A-C, thereby keeping the A-C free to stimulate the effector cells. Eserine does not act directly upon the effector cells.

It must be kept in mind constantly that we are dealing with a unit, consisting of nerve terminals, effector cells, and the neuro-effector junction.

The implications of this theory are that the normal performance (release of A-C,

the neutralizing effect of esterase, contraction, inhibition, secretion) of the neuro-effector unit, setting the effector cells into action, depends on the following factors:

1. The normal condition of the nerve fibers and nerve terminals.
2. The "secretion" or release of normal amounts of A-C or sympathin, respectively.
3. The state of reactivity of the effector cells.
4. The release and accurate timing at the parasympathetic-nerve terminals of a normal amount of esterase, which neutralizes the surplus A-C. (No similar substance has been found for sympathin.)

If the essential principles of the theory of chemical mediation of nerve impulses and the implications derived from them are kept in mind, the mode of action of the various groups of miotics can be better understood and the indications for the use of each individual group foreseen.

*Mecholyl* and *doryl*, chemically related to A-C but much more effective, act directly upon the effector cells just as if an impulse, traveling along the nerve, has released the chemical mediator (A-C). These drugs do this, even in the absence of a nerve impulse or when the intensity of the impulse is diminished (provided that the effector cells are still tolerably intact).

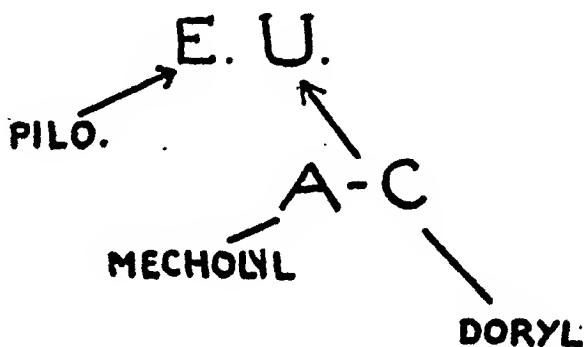


Fig. 4 (Schoenberg). Pilocarpine and acetylcholine (mecholyl, doryl—the related substances) have a direct stimulating effect upon the effector unit (E.U.).

The action of *eserine* and *prostigmin* takes place at the neuro-effector junction. It prevents the esterase from neutralizing entirely the A-C (unless these drugs are given in doses too strong or too frequent) and, thereby, gives it a chance to act upon the effector cells (motile and secretory). Eserine does not act directly upon the effector cells if no A-C is released.

*Pilocarpine* stimulates the effector cells directly, if they are chemically receptive.

#### IS GLAUCOMA A DEFICIENCY DISEASE?

In the early stages of glaucoma, in which the balancing mechanism for the maintenance of a normal intraocular pressure is out of order to a certain degree, the pilo-eserin-acetylcholine groups bring about a *partial* and *temporary* restitution of the function by their specific action upon one or several constituent parts of the neuro-effector unit. The necessity of repeated instillations of these drugs at regular intervals, the need of a definite dosage, and the recurrence of the hypertension when the medication is discontinued beyond a certain time limit, lead one to believe that there is a similarity between glaucoma and deficiency diseases such as myxedema, cretinism, diabetes, night blindness, pellagra, scurvy, and the like, in which a fairly normal function can be reestablished by a constant and regular replacement therapy; namely, thyroid extract, insulin, vitamins A, B, C, and pilocarpine-eserine-acetylcholine, respectively. The indications for the preference of using pilocarpine, or eserine-prostigmin, or acetylcholine-mecholyl-doryl, are to be based on the decision made as to which constituent part of the effector unit and of the neuro-effector junction is out of order and as to which deficiency is to be replaced!

*Pilocarpine* and *acetylcholine* (with its chemical derivatives doryl and mecholyl) are indicated in cases in which there is a

lack or diminution of production of A-C. There are reasons to believe that doryl, mecholyl, and pilocarpine do not all stimulate the same constituent parts of the effector unit. One of these reasons is that in some cases pilocarpine is more effective than the acetylcholine group and vice versa.

*Eserine* and *prostigmin* are not effective in reducing ocular hypertension in cases in which there is a lack of acetylcholine liberation at the neuro-effector junction, and also in those in which the effector unit has lost its effectiveness. These drugs act only in cases in which A-C is liberated, but neutralized too soon by choline esterase.

The problem is, then, to find a method that could inform us as to the various phases of the chemical mediation processes and the effectiveness of the individual constituent parts of the neuro-effector unit, charged with the regulating mechanism of the intraocular pressure.

Such a method is being studied at present and the technique of the tests will be reported in due time.

#### SUMMARY

The guiding principles in the treatment of glaucoma simplex are: (a) to eliminate or alleviate disturbances due to ill health; (b) to advise patients repeatedly about ways of maintaining good health; (c) to determine the stage and type of glaucoma, the age and type of the patient, and to treat accordingly; (d) to learn more about the mode of action of the drugs used in the local treatment of glaucoma, the frequency of application, dosage, intentional interruptions of treatment, timing, and combination of drugs; (f) to pay utmost attention to minutest details; (g) to think always along clinical lines; to consider the probability that glaucoma is a deficiency disease.

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# OCULAR FINDINGS IN FEEBLE-MINDED MALE CASTRATES\*

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During the past 10 years sex hormones have gradually been gaining therapeutic prominence. Apparently these chemical substances have been playing powerful though hidden roles in hitherto-unsuspected situations. Countless investigators during recent years have been devoting much time and effort to the study of the sex hormones in relation to the human organism as a whole as well as in relation to the sex characteristics alone. In studying the results, so far, one gains the impression that large amounts of apparently unrelated data have been assembled, and yet, here and there, facts emerge which may assume or have already assumed significance.

Ophthalmologic examination was suggested by Hamilton,<sup>1</sup> who had noted that eunuchs of normal mentality almost invariably commented upon improved vision for distant objects while undergoing male-hormone therapy. The subjective improvement in distance vision was maintained only during the period of male-hormone therapy; it regressed with cessation of therapy, and returned again with subsequent administration of the hormone. It was decided that the problem was of sufficient interest to warrant investigation.

The question of subjects for the investigation was solved through the courtesy of Dr. C. C. Hawke, Chief Surgeon at the Kansas State Training School for the Feeble Minded, of Winfield, Kansas. Pilcher performed the first male castration in this institution in 1894 and the group now numbers about 250. Hawke<sup>2</sup>

said, "If we can do anything to pacify the highly emotional and those whose management is very difficult, be they idiot, imbecile, or moron, such a procedure should be given serious consideration." Problems at such an institution include fighting, hysterical outbursts, attacks on young children, rape of children, lack of coöperation, and excessive masturbation. Following castration, these same individuals were markedly improved in over 85 percent of the cases and a behaviour problem no longer existed. Material for an ophthalmologic investigation was therefore made up of 17 male castrates examined as completely as possible before and after they had been given a course of male-hormone therapy.

Therapy consisted of a course of 21 daily injections of 20 mg. of testosterone propionate in sesame oil† given intramuscularly, alternately in each hip. Examination included refraction, muscle balance, convergence and accommodation near-point determination, intraocular pressure, pupillary measurements, visual fields (peripheral and central), and fundus studies. Since no slitlamp was available, no biomicroscopic examinations could be made, which was unfortunate. It should be stated here that examination of these patients offered some difficulty particularly since the majority of tests were of necessity subjective. For example, it was found absolutely impossible to get accurate readings for the near point of accommodation because the mentality of the subjects was not sufficient to enable

\* From the Washington University School of Medicine, Department of Ophthalmology, Oscar Johnson Institute.

† Testosterone propionate, under the trade name Perandren, was furnished through the courtesy of the Ciba Pharmaceutical Products, Inc.

TABLE 1  
EXAMINATION OF WHITE MALE CASTRATES

Name	Age years	Refraction		Corrected Vision		Muscle Balance		N.P.C. cm.	
		Before Therapy	After Therapy	Before Ther.	After Ther.	Before Ther.	After Ther.	Before Ther.	After Ther.
1. C. M.	51	O.D. -6.50 O.S. +3.50 ax. 90°	O.D. -6.50 O.S. +3.50 ax. 90°	O.D. 20/50 O.S. 20/70	O.D. 20/70 O.S. 20/70	O' O'	O' X' 5	10	10
2. A. H.	35	O.D. -0.50 O.S. -0.50	O.D. -0.50 O.S. -0.50	O.D. 20/30 O.S. 20/30	O.D. 20/30 O.S. 20/30	O' O'	O' X' 4	8	16
3. H. F.	59	O.D. +0.75 O.S. +0.50	O.D. +0.75 O.S. +0.75	O.D. 20/10 O.S. 20/10	O.D. 20/10 O.S. 20/10	O' O'	O' X' 6	7	12
4. S. M.	46	O.D. +1.25 +0.25 ax. 180° O.S. +0.25 +0.75 ax. 180°	O.D. +1.25 +0.25 ax. 180° O.S. +0.75 ax. 180°	O.D. 20/50 O.S. 20/20	O.D. 20/50 O.S. 20/50	Esotropia	Esotropia	—	—
5. D. B.	43	O.D. +1.00 O.S. -0.50 +2.00 ax. 115°	O.D. +0.75 O.S. -0.50 +2.00 ax. 115°	O.D. 20/20 O.S. 20/20	O.D. 20/20 O.S. 20/20	S' 5 X' 3	O' X' 6	17	20
6. H. H.	44	O.D. +0.75 +0.75 ax. 180° O.S. +0.75 +1.00 ax. 180°	O.D. +0.75 +0.75 ax. 180° O.S. +0.75 +1.00 ax. 180°	O.D. 20/30 O.S. 20/30	O.D. 20/20 O.S. 20/20	O' X' 2	O' X' 2	5	5
7. A. F.	33	O.D. +1.25 ax. 130° O.S. +0.37	O.D. +1.25 ax. 130° O.S. +0.25	O.D. 20/20 O.S. 20/20	O.D. 20/20 O.S. 20/20	O' O' H' 2 O.U.	O' O' H' 2 O.U.	12	10
8. C. M.	22	O.D. -0.50 O.S. -1.00 ax. 90°	O.D. -0.75 O.S. +0.25 -1.00 ax. 90°	O.D. 20/20 O.S. 20/20	O.D. 20/20 O.S. 20/20	O' X' 5	O' X' 5	8	7
9. G. S.	25	O.D. Emmetropic O.S. Emmetropic	O.D. Emmetropic O.S. Emmetropic	O.D. 20/10 O.S. 20/10	O.D. 20/10 O.S. 20/10	O' X' 3	O' X' 2	11	15
10. M. H.	31	O.D. +0.25 O.S. +0.25	O.D. Emmetropic O.S. Emmetropic	O.D. 20/30 O.S. 20/30	O.D. 20/30 O.S. 20/30	O' X' 7	X' 4 X' 10	20	15
11. E. G.	55	O.D. +2.25 O.S. +1.50 +1.00 av. 180°	O.D. +2.25 O.S. +1.50 +1.00 ax. 180°	O.D. 20/50 O.S. 20/200	O.D. 20/50 O.S. 20/200	O' O'	S' 3 O'	17	15
12. Er. G.	54	O.D. -4.00 +6.00 ax. 180° O.S. -1.00 ax. 125°	O.D. -4.00 +6.00 ax. 180° O.S. -1.00 ax. 125°	O.D. 20/100 O.S. 20/100	O.D. 20/100 O.S. 20/100	S' 2 X' 6	O' X' 6	16	16
13. P. H.	46	O.D. -0.75 O.S. -2.00 -0.50 ax. 180°	O.D. -0.75 O.S. -2.25 -0.50 ax. 180°	O.D. 20/50 O.S. 20/50	O.D. 20/50 O.S. 20/50	O' O'	O' X' 5 RH' 3	12	12
14. O. S.	27	O.D. +0.25 O.S. +0.25	O.D. Emmetropic O.S. +0.25	O.D. 20/10 O.S. 20/10	O.D. 20/10 O.S. 20/10	O' X' 3	X' 2 X' 4	7	6
15. G. F.	37	O.D. -4.00 ax. 180° O.S. -1.25 -0.50 ax. 180°	O.D. -4.00 ax. 180° O.S. -1.25 -0.50 ax. 180°	O.D. 20/200 O.S. 20/70	O.D. 20/100 O.S. 20/70	O' X' 8	O' X' 8	14	12
16. E. B.	65	O.D. -3.50 +1.50 ax. 180° O.S. -0.50 +0.75 ax. 180°	O.D. -4.25 +1.50 ax. 180° O.S. -1.00 +0.75 ax. 180°	O.D. 20/20 O.S. 20/20	O.D. 20/70 O.S. 20/30	X' 15 X' 20	X' 10 X' 25	None	None
17. K. L.	51	O.D. +0.25 +0.25 ax. 90° O.S. +0.25 +0.25 ax. 90°	O.D. +0.25 +0.25 ax. 90° O.S. +0.50 +0.25 ax. 90°	O.D. 20/20 O.S. 20/25	O.D. 20/20 O.S. 20/20	S' 5 S' 1	S' 5 S' 1	12	12

O=orthophoria S=esophoria X=exophoria ' =at 20 feet ' =at 14 inches

them to coöperate satisfactorily. Visual fields were extremely difficult to obtain accurately on either the perimeter or tangent screen; however, in questionable cases, confrontation fields always indicated a normal field. In only two cases was it found impossible to get any visual fields.

*Age group.* Ages of the group ranged from 22 to 65 years, with the following distribution: 20-29 years, 3; 30-39 years, 4; 40-49 years, 4; 50-59 years, 5; 60-69 years, 1. All were healthy white males

with the exception of C. M. (case 1), who was a well-controlled diabetic.

*Refraction.* The refractive condition of eyes of the group was about that which could be expected of any average cross section of the population. Of 46 eyes examined (6 castrates were examined who did not receive hormone therapy and were for that reason left out of the total group for study) in 23 patients, there were 16 eyes with some form of myopia (simple myopia, single myopic astigmatism, com-

TABLE 1 (Continued)  
EXAMINATION OF WHITE MALE CASTRATES

Tension mm. Hg (Schiotz)		Pupils mm.		Iris	Fields		Fundus and Miscellaneous	
Before Ther.	After Ther.	Before Ther.	After Ther.		Before Ther.	After Ther.	Before Therapy	After Therapy
O.D. 22 O.S. 22	O.D. 19 O.S. 17	2	2	Blue	O.K.	O.K.	Diabetic retinitis with hemorrhages and exudates, O.U. Arteriosclerosis O.U. On therapy for diabetes (protamine zinc, diet, etc.)	All exudates disappeared. One hemorrhage left in O.D., few in O.S.
O.D. 20 O.S. 17	O.D. 17 O.S. 13	4	4	Blue	O.K.	O.K.	Normal	Same
O.D. 11 O.S. 11	O.D. 15 O.S. 15	3	O.D. 2 O.S. 3	Blue	O.K.	O.K.	Diffuse colloid degeneration of retina O.U. Moderate arteriosclerosis, O.U.	No change
O.D. 15 O.S. 15	O.D. 15 O.S. 15	4	4	Blue	O.K.	O.K.	Nevus on disc, O.D.	No change
O.D. 11 O.S. 11	O.D. 11 O.S. 11	3	3	Hazel	O.K.	O.K.	Neuroglial tissue on disc, O.D. Anomalous venous tortuosity, O.U.	No change
O.D. 15 O.S. 15	O.D. 18 O.S. 18	2.5	2.5	Blue	O.K.	O.K.	Normal	Same
O.D. 17 O.S. 19	O.D. 15 O.S. 19	3	3	Brown	O.K.	O.K.	Glial sheath on vessels at disc, O.U.	No change
O.D. 19 O.S. 22	O.D. 15 O.S. 15	3	3	Blue	O.K.	O.K.	Normal	Same
O.D. 10 O.S. 9	O.D. 9 O.S. 9	4	4	Brown	O.K.	O.K.	Neuroglial tissue on discs and sheathing vessels at disc, O.U.	Neuroglial tissue disappeared entirely, O.U.
O.D. 15 O.S. 15	O.D. 15 O.S. 15	3	3	Brown	O.K.	O.K.	Normal	Same
O.D. 15 O.S. 19	O.D. 17 O.S. 15	5	5	Blue	?	?	Partial optic atrophy, O.S. Immature cataract, O.S.	No change
O.D. 8 O.S. 6	O.D. 15 O.S. 11	O.D. 4 O.S. 3	O.D. 4 O.S. 3	Blue	?	?	Partial optic atrophy, O.U. Diffuse colloid degeneration, O.U.	No change
O.D. 19 O.S. 19	O.D. 15 O.S. 17	3	3*	Blue	O.K.	O.K.	Fundi normal. Immature wedge-shaped lens opacity, O.S.	Great decrease in lens opacity objectively!
O.D. 15 O.S. 15	O.D. 15 O.S. 15	3	3	Brown	O.K.	O.K.	Normal	Small lens opacity now present in O.S.
O.D. 11 O.S. 12	O.D. 15 O.S. 15	4	4	Blue	O.K.	O.K.	Myopic retinal degeneration, O.U.	No change
O.D. 25 O.S. 25	O.D. 25 O.S. 19	3	3	Blue	O.K.	O.K.	Moderate arteriosclerosis, O.U. Immature cataracts, O.U.	Slight but definite progress of cataracts, O.U.
O.D. 9 O.S. 15	O.D. 9 O.S. 11	4	4	Hazel	O.K.	O.K.	Normal except for iris coloboma, O.S.	A wedge-shaped lens opacity now present at site of iris coloboma in O.S.

pound myopic astigmatism, and mixed astigmatism) or 34.7 percent; of these 16, 4 presented an index myopia due to developing lenticular opacities; if these be discarded, the incidence of curvature and axial myopia drops to 26 percent. While this figure is somewhat low, it might be expected in a group of illiterates who do practically no close work. The figure is therefore interesting but not significant. In every patient, if the vision could not be improved to 20/20, there was some obvious reason for the difficulty; for example, cataract or retinopathy.

*Muscle balance.* The most interesting finding in the entire study had to do with muscle balance. Following hormone therapy there was noted, in 10 out of the 17 patients in the group, a very definite development of an exophoria. If orthophoria had existed prior to treatment, usually an exophoria developed; if esophoria was found before treatment, it either definitely decreased, disappeared entirely, or became converted into an exophoria. Of the remaining seven patients, six showed no change from a previous orthophoria or exophoria, while the re-

maining subject had a monocular esotropia, concomitant in type. The usual finding was an orthophoria both at 20 feet and at 14 inches; then, following male-hormone therapy, the majority were still orthophoric at 20 feet but had developed between 4 and 5 prism diopters of exophoria at 14 inches. Measurements were made with loose prisms with the use of the cover test, and are believed to be accurate.

*Near point of convergence.* This was easy to determine in these patients and is also thought to be accurate. Readings for the entire group were practically identical before and after hormone therapy, despite the evident development of an exophoria at 14 inches. The interesting thing here is the marked prevalence of convergence insufficiency in this group. If we take a value of 8 cm. as the highest limit of normal average convergence near point, of the 23 castrates studied only 4 could be called normal. Accordingly a group of male noncastrates, 21 in all, of similar ages were examined and of these only 6 could be found with a convergence near point within normal limits. If we merge these two groups, we have 44 subjects of whom 10 had a normal convergence near point, a percentage of 22.7. Whether or not this condition is a result of the habits of their daily existence or is associated in some way with a deficient mentality must remain for the present a subject of speculation. In the patients studied, there was no correlation between age and the convergence near point.

*Intraocular pressure.* No significant variation whatever was found in the intraocular pressure as measured with the Schiötz tonometer before and after male-hormone therapy. The same was true of pupillary diameters.

*Visual fields.* As has been mentioned before, visual fields were extremely difficult to obtain and were worthless in the majority of cases. There was an amazing prevalence of tubular fields as recorded for both tangent screen and perimeter, yet confrontation tests revealed normal fields, and the patients had no difficulty in getting about in the pursuit of their daily tasks. The patients could literally be worked into a frenzy of concentration in an attempt to maintain fixation on the central target and this had the effect of blotting out the test object moving in from the periphery until it almost reached the fixation point. An occasional fatigue or hysterical "corkscrew" field was obtained. For these reasons, fields were considered worthless and no conclusions can be drawn from them.

*Fundi.* The fundi showed little of interest, with two notable exceptions. In the first case (C. M., case 1) the patient had been a diabetic for years and well controlled with a simple dietary regime plus protamine-zinc insulin. When first seen, he had fundi typically associated with diabetes; that is, multiple pinpoint and flame-shaped hemorrhages and numerous perimacular soapy, hard, yellowish-white, discrete patches of exudate. Less than four months later and after 21 days of male-hormone therapy, the fundus of the right eye presented only a single flame-shaped hemorrhage, and the exudates and other hemorrhages had disappeared entirely, leaving no trace; the left eye showed a marked decrease both in the number of hemorrhages and of exudative patches. And this in a well-controlled diabetic! In our experience it is not at all unusual for the hemorrhagic picture to change from time to time, but it is very rare that one sees so-called diabetic exudates disappear entirely, particularly in the short space of four months' time.

The other instance seems even more remarkable. G. S. (case 9), when first examined, had on each optic-disc surface a mass of neuroglial tissue covering at least one half of the disc area and in addition sending neuroglial sheaths along the superior retinal vessels from the disc for a distance of at least 0.5 disc diameter over the surface of the retina. After a course of hormone therapy, and eight months after the original examination, no trace of the neuroglial tissue could be seen in either fundus!

*Changes in the media.* The only findings not described as yet have to do with lenticular opacities. O.S. (case 14), aged 27 years, had entirely clear lenses prior to hormone therapy; following therapy, there were noted in the crystalline lens of the left eye two sharply delimited anterior subcapsular round opacities located in the vertical meridian near the periphery (at the 12-o'clock position).

Another subject, K. L. (case 17), on the first examination was noted to have a peripheral iris coloboma at the 2-o'clock position, in the left eye but no lens opacity; following male-hormone therapy (eight months after the original examination) a definite wedge-shaped zonular opacity was noted at the coloboma site, and there was no history of trauma during the period between examinations.

The third case of interest was in P. H. (case 13), who on the first examination was noted to have numerous peripheral lens riders of an immature cataract in the left eye; these could be easily visualized with an ophthalmoscope, standing out against the fundus reflex. When examined following a course of hormone therapy (after eight months) the lens opacities could not be seen at all! However, vision remained unchanged.

In three other cases of immature cataract, a normal amount of progression

of the opacification was noted over an eight-month period.

### DISCUSSION

Little discussion is possible because of very limited knowledge. The facts in the study are at times very difficult to explain, and yet they are facts. The finding of convergence insufficiency in feeble-minded (and hence illiterate) individuals is not a surprise. The development of exophoria following male-hormone therapy remains an intriguing and unexplained finding. Hamilton<sup>3</sup> has suggested that the diabetes in case 1 (C. M.) may represent the unusual type of diabetes similar to that which occurs in women after the menopause. In these cases of low levels of sex hormones some change in diabetic condition has been reported by certain investigators following sex-hormone therapy. The effect of male-hormone therapy on immature cataract in selected cases presents an interesting problem.

Of interest is the amazingly low incidence of glaucoma in the feeble-minded group as a whole. The Kansas State Training School has a census of approximately 1,250, and these patients receive excellent medical attention. Any congestive glaucoma would be noted, but there are only a handful of cases on record, and yet over half of the patients are in the age group of glaucoma. Incidentally, the incidence of peptic ulcer in this group is remarkably low, and this is not surprising provided our ideas of "hustle and bustle of modern life" in the etiology of both glaucoma and peptic ulcer are correct.

### CONCLUSIONS

Seventeen male castrates were ophthalmologically examined before and after the administration of therapy with the male sex hormone. Convergence insufficiency is quite prevalent among the feeble-minded.

Castrates showed a definite tendency to develop exophoria following hormone therapy. A remarkable regression of fundus retinopathy was noted in the only diabetic in the group following therapy. An immature cataractous opacity was

markedly decreased in density following therapy, while two other cases developed anterior subcapsular peripheral zonular cataracts following or during male-hormone therapy.

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### CHOKED DISCS AND LOW INTRATHECAL PRESSURE OCCURRING IN BRAIN TUMOR\*

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Although the theory that attributes choked discs to compression of the central vein in the vaginal space gives the most acceptable explanation, it is readily granted that this interpretation does not satisfy in all cases of choked disc. In those patients in whom a high cerebrospinal-fluid pressure is present but in whom choked discs are absent, there is no completely satisfactory explanation for the failure in development of edema of the nerve heads. In cases with low intrathecal pressure and edema of the nerve heads, we are usually confronted with one of two possibilities. Either the patient is suffering from an inflammatory condition of the optic-nerve heads, and the diagnosis of papillitis usually can be made upon the basis of loss of central vision, or a brain tumor is present, and the finding of a normal intrathecal pressure as obtained by lumbar puncture confuses the diagnostician and may result in

incorrect interpretation of the clinical syndrome. The occurrence of choked discs without increased intrathecal pressure thus becomes an important problem, the clarification of which will lead to earlier diagnosis and better understanding of the mechanism of production of edema of the nerve heads in brain tumor. This subject as it concerns inflammations of the optic nerves has been adequately discussed in articles by Dandy<sup>1</sup> and more recently by Bedell.<sup>2</sup>

While studying a group of patients who had choked discs and proved brain tumors, it was found that a number of them had normal intrathecal pressure, as obtained upon lumbar puncture (less than 200 mm. of water). Inasmuch as we ordinarily consider 200 mm. of water as the lower limit at which choked discs develop, the low levels obtained seemed paradoxical. This appeared to be especially confusing in view of an experience with the papilledema that occurs in the course of a retinitis associated with general diseases, in which we<sup>3</sup> had determined 200 mm. as the dividing line between the edematous and nonedematous state of the nerve head.

\*From the Department of Ophthalmology, College of Medicine, State University of Iowa. Presented before the American Ophthalmological Society, at Hot Springs, Virginia, June, 1943.



Since the visual acuity was normal in all cases in which it could be obtained, it was not believed that an inflammatory condition of the nerve was present. Furthermore, the clinical state of the patients made it appear certain that the seemingly anomalous occurrence of the choked discs was directly related to the brain tumor.

In order to understand more fully the circumstances associated with the edematous nerve heads and the low intrathecal pressure, a careful study of the records of these patients was made. The significant data from the records of 12 patients with brain tumor, low intrathecal pressure, and choked discs are presented in table 1. This group was obtained from a series of 80 patients with choked discs in whom there was a positive diagnosis of brain tumor. In 68 patients the cerebrospinal fluid was above 200 mm. of water, with an average of 343 mm. The pressure obtained upon lumbar puncture in the remaining 12 patients was below 200 mm. of water, and averaged 123 mm. In order to determine the usual pressure in patients with brain tumor but without choked discs, an additional 38 cases were selected. In these the pressures varied from 520 to 80 mm. of water, the average being 187 mm. The average pressure of 29 of the 38 patients who had pressure readings below 200 mm. of water was 140. It is seen, therefore, that the average for the 12 cases presented is below the average for the brain-tumor cases without choked discs.

The table contains most of the significant information concerning the patients. In cases 4 and 12 it is obvious that a block had occurred which prevented free circulation of cerebrospinal fluid from the cranial cavity to the spinal cord. In case 5 the low pressure suggests a block but compression of the jugular veins had not confirmed this. The tabulation of cases is made in the order of severity of signs and

symptoms of increased intracranial pressure. In the first cases there was little or no clinical evidence of increased intracranial pressure, whereas in the later cases the symptoms were extreme. The patient in case 9 had had a decompression 16 months prior to the admission reported, but his postoperative course had been entirely satisfactory until eight weeks prior to the present admission. In the last three cases there was definite evidence of rapidly increasing intracranial pressure.

### DISCUSSION

The information available on these patients does not permit exact conclusions, but it indicates that in special circumstances choked discs and increased intracranial pressure may occur in brain tumor in the absence of an increase in cerebrospinal fluid pressure upon lumbar puncture. Since this event is contrary to the usually accepted theory for production of edema of the nerve head, it is necessary to show that there really existed a pathologic swelling of the papilla, that this swelling was not inflammatory in type, and finally that a block did not exist in the spinal-fluid circulation at the time of the lumbar puncture.

Pseudoneuritis occasionally can simulate very closely the swollen appearance of a pathologic nerve head, and in patients in whom cerebral pathology is suspected the occurrence of this condition can be very confusing and misleading. However, in pseudoneuritis, hemorrhages are not seen, the apparent elevation is not subject to change from time to time, the veins are not engorged, and the thickening of the retina is not opaque as in true choking. Furthermore, the elevation is usually not of a measurable degree, and the blind spot is of normal size when mapped on the Bjerrum screen. In each case presented in this report the possibility of pseudoneuritis was considered, and

TABLE 1  
SIGNIFICANT DATA FROM THE RECORDS OF 12 PATIENTS WITH BRAIN TUMOR, LOW INTRATHECAL PRESSURE, AND CHOKED DISCS

Name	Age years	B. P.	Diagnosis	Position	Vision	Symptoms		Cer. Sp. Fl. Pr.	Observation Interval	Remarks
						Duration	Most Prominent			
1. R. F.	60	135/80	Glioblastoma	Left temporal	Rt. hom. hem. 6/6	10 days	Aphasia	160 HOH	11 days	Clinically and operatively no evidence of increased intracranial pressure except choke. Patient died during encephalography. Brain showed signs of increased intracranial pressure.
2. K. S.	48		Astrocytoma	Left fronto-parietal	6/6	2 years	Increasing headache	185	7 days	Brain under marked tension. Choke subsided after laminectomy and X-ray therapy in cervical region. Obstruction present.
3. L. E.	35	120/80	Astrocytoma	Left frontal	6/9	6 months	Headaches and vomiting	156	17 days	Internal hydrocephalus at operation.
4. P. L.	11		Glioma	Cervical cord	6/6	2½ mos.	Weakness arms and legs; headache	40		
5. D. B.	19	110/80	Arachnoid cyst	Cerebellum	6/6	4 months	Increasing headaches and vomiting	78	3 days	
6. H. S.	23		Bronchogenic ca.	Cerebellum and cerebrum		2½ weeks	Headaches and vomiting	156	18 days	Slight pressure cone and flattened gyri. Clinical signs of increasing intracranial pressure during last week.
7. R. W.	12	120/90	Medulloepithelioma	Subtentorial	6/9	3 weeks	Headaches, vomiting, and listlessness	130	2 days	Internal hydrocephalus. Clinical signs of increased intracranial pressure.
8. A. B.	45	130/70	Glioblastoma	Left temporal	Rt. hom.	7 months	Headache and vomiting	180	3 days	Brain under considerable tension. Clinical signs of increased intracranial pressure.
9. J. C.	44	110/76	Astrocytoma	Rt. frontal and temporal		8 weeks	Headache and unconscious spells	156	19 days	Increasing signs of elevated intracranial pressure. Tight decompression.
10. R. B.	48	180/100	Glioblastoma	Rt. temporal and hypocalympyrus	6/9	9 months	Expanding headache, dizziness, confusion	120	6 days	Rapidly developed signs of increasing intracranial pressure. Brain very tense.
11. C. M.	48	108/60	Glioblastoma	Rt. frontal, parietal, and temporal		5 years	Headaches and vomiting, semistuporous	125	3 days	Rapidly developed signs of increasing intracranial pressure. Internal hydrocephalus and brain under great tension.
12. C. W.	54		Glioblastoma	Right frontal, temporal, and parietal		10 days	Headache, stupor one day	5	1 day	Clinically was in extremis because of increased intracranial pressure. Medulla was herniated into foramen magnum.

only those patients were included concerning whom there was no doubt as to the diagnosis. Several examiners viewed each case and there was uniformity of opinion. Definite changes in the appearances of the nerve heads were observed in some patients during the preoperative period of study.

The diagnosis of inflammatory swelling of the nerve head at times may be difficult, for the ophthalmoscopic appearance of the nerve head may be the same as in choked disc. However, in papillitis the visual acuity is lost early because of the central scotoma that accompanies the process, whereas in choked disc visual acuity is retained sometimes for months. Rarely cases are seen in which this generalization does not apply, but in those cases if a correct diagnosis can be made it is obvious from the accompanying general signs and symptoms. In each case reported the visual acuity, if obtainable, was normal. This fact in addition to the positive diagnosis of brain tumor in all patients should adequately eliminate the possibility of inflammation.

The most difficult problem concerns the cerebrospinal-fluid pressure. In two patients (4 and 12), a definite block in the spinal circulation was demonstrated. In patient 5 the low pressure (78 mm.) suggested a block, but compression of the jugular veins resulted in the normal rise in the lumbar pressure. In all other cases the response to jugular compression was normal. Further discussion of possible obstruction must be entirely speculative, for neither clinical nor pathologic evidence in these cases indicated an intermittent type of hydrocephalus. It is highly improbable that in certain cases there may be a partial obstruction that does not prevent a rise in pressure on jugular compression. No criticism can be made of the technique of lumbar puncture, for the examinations were in all cases made by reliable operators.

The fact remains, however, that these patients showed clinical evidence of increased intracranial pressure. In the table the first patient showed no evidence of increased intracranial pressure, but all others in succession showed increasing signs of hydrocephalus. From the clinical standpoint, the appearance of the choked discs was reasonable and to be expected. Pathologic investigation confirmed the clinical impression, for in every case the brain showed definite evidence of increased intracranial pressure either at operation or *post mortem*. In some the meninges were tense while in others the gyri were flattened, an internal hydrocephalus was present, or a cerebellar pressure cone was observed. This gives further evidence that true choked discs were present, and that they were due to increased intracranial pressure which for unknown reasons was not recorded by lumbar puncture.

One might speculate that the recorded pressures in these cases were high for these particular patients, and that normally the pressures were considerably lower. This does not appear to be a logical assumption, especially when the pathologic findings of increased intracranial pressures are considered. In a similar manner, definite conclusions cannot be made regarding the effects of slowly and rapidly rising pressure in these patients. A rapidly rising pressure is more likely to produce choked discs and other signs and symptoms, but in the patients reported there was nothing to indicate that a rapidly rising intracranial pressure was responsible for the symptomatology. The fact that the pressure rose rapidly after admission in two patients is not significant as far as the choked discs in all the patients are concerned, but perhaps contributed to the pathologic appearance of the brain and meninges.

From the evidence available, it seems most advisable to consider these patients as cases of true hydrocephalus in whom

the choked discs were clinical manifestations of the intracranial disease. In this event the choked discs would be produced in the normal manner by the increased pressure compressing the central vein in the vaginal space of the optic nerve.

The low lumbar-puncture pressure remains unexplained, but it is perhaps less significant than are the choked discs and the clinical symptoms in the diagnosis of increased intracranial pressure in cases of this type.

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### THE RELATIONSHIP OF ORTHOPTIC TREATMENT TO SURGERY\*

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I discussed this subject in a previous paper and am repeating it here with some variations because it was asked for by your committee. For the past 25 years the pendulum has been gradually swinging from cosmetic improvement toward restoration of function in the surgical treatment of strabismus. This is seen in the writings of Jameson,<sup>1</sup> Dunnington, and Wheeler,<sup>2</sup> myself,<sup>3, 4</sup> and others.

Surgical treatment of strabismus was originally designed mostly for cosmetic improvement. With advances in the differential diagnosis and surgical procedures, restoration of function seems to have become the dominant purpose in the treatment of strabismus. Orthoptic training seems to be the connecting link between cosmetic surgery and restoration of normal function or real cure.

In the general consideration of orthoptic training, the question naturally arises: By whom and where should it be carried out? Inasmuch as it involves an understanding of psychology, physiology, and

pathology, and is quite closely related to surgical treatment, it seems to belong in the sphere of medicine, particularly ophthalmology. The ophthalmologist, however, already is a busy man. Can he find the time necessary to devote to this added burden? Not without assistance, I believe. Neither does it seem that orthoptic treatment should be turned over to nonmedical fitters of glasses who are untrained in the necessary fundamental sciences and who, without supervision, might exploit this form of treatment. The problem seems to have been solved by the development of carefully trained technical workers who carry out treatment under the supervision of, and in coöperation with, the ophthalmologist interested in the problem. I am very proud of the Association of Orthoptic Technicians. You have made real progress and are doing a fine job.

In connection with the actual training, the question is often asked: How long should it be continued? The answer, it appears, is that it should be continued for as long as satisfactory and definite progress is being made. The value of orthoptic training in any given case cannot

\* From the Section of Ophthalmology, Mayo Clinic. Read before the meeting of the American Association of Orthoptic Technicians, Chicago, Illinois, October 12, 1942.

be established in a few months. In some of our most successful cases at the Mayo Clinic, patients have been trained continuously for several years. One particularly successful result that I have in mind was obtained after three years of intensive training, during which there were periods of marked relapse. In selected cases and under favorable circumstances, training can be carried out for from three to five years with good results. In most cases, however, operation should be performed much sooner than this, and further training should be given subsequently.

There is a natural tendency, once training is started, to hang on stubbornly past the point where surgery should be performed. I believe that early operation is indicated in many instances. The ideal procedure in any given case would seem to be a preliminary period of orthoptic training then operation, and, finally, further training. Too often, after a successful operation has been performed and the eyes appear to be straight, the family and the surgeon lose interest and further treatment is not given.

In discussing some of the relationships between surgical treatment and orthoptic training, the question naturally arises as to when to operate. Savin<sup>5</sup> might well have opened this discussion when he stated that surgical measures under modern conditions, and with modern needles and instruments, could be carried out safely at any age beyond that of three years. He also thought that cosmetically successful operations should be followed by further orthoptic training. Griffith<sup>6</sup> saw the pendulum swinging rapidly toward earlier operation when nonoperative measures, reasonably tried, failed to produce results. Maddox<sup>7, 8</sup> thought operation desirable when other measures seemed to have failed, and particularly if the time involved seemed to jeopardize the brain eye and this regardless of the youthfulness

of the patient. His youngest patient was 16 months old. Thus far, at the Mayo Clinic, our youngest patient has been three years old.

Hine,<sup>9</sup> although he objected to operating with the patient under the influence of general anesthesia because of the resultant difficulty in watching the eyes, felt that if treatment was delayed until after the age of seven years, the chances for recovery would be remote. The answer to this seems to be: Why delay so long? Davis<sup>10</sup> made the point that it was most important to effect a cure at a preschool age by means other than glasses; that is, by orthoptic training or operation, thus avoiding the mental trauma of strabismus and the wearing of glasses. The age of the patient, then, no longer seems to be the determining factor in the problem of when to operate. We must depend rather on the degree and nature of the strabismus, the condition of the visual apparatus, and the response or lack of response of the latter to training. Feasibility and availability of the patient for training naturally must be considered.

When extensive deviations have to be dealt with, and there is no opportunity to try orthoptic training, it would appear sensible to straighten the eyes surgically and give parallelism a chance. I have seen fusion develop spontaneously among both adult persons and children, after operation, when no training had been given. Certainly this is better than merely to dismiss the patient with a pair of glasses. Failure of the condition to respond within a reasonable length of time to refraction and orthoptic training, properly carried out and sufficiently tried, seems to be the prime indication for surgical intervention. Just what constitutes a reasonable length of time seems in the light of present opinion to be six months to a year. Surgery should be resorted to if there is a tendency toward relapse from the

point of either strabismus or amblyopia, and also if excessive contracture of the muscles continues unabated and the opposing muscles appear to be weakening.

In the persistently refractory case in which a vertical deviation is present, probably it is best in most instances to correct the vertical deviation surgically. The eyes then will often proceed toward cure. If the patient has made progress up to a certain point with training, but is then unable to continue, or if the physician senses lagging interest on the part of the patient and his family, operation would seem to be the next step. In high degrees of strabismus, after the patient has obtained good vision and simultaneous perception by training, operation designed to reduce the angle of the strabismus would seem to save valuable time. This is then to be followed by further training. As Berens, Payne, and Kern<sup>11</sup> have stated it is important to operate in all cases in which the condition does not respond to nonoperative measures, and to put the eyes in a position in which they may be able to respond. Hine<sup>9</sup> called attention to the group of strabismic patients whose eyes remain straight while they are stimulated by training, but in the ordinary course of life return to their former state. These patients, he felt, should be operated on.

The indications for orthoptic training seem to be definite. To determine in any given case whether surgical aid is necessary, orthoptic training should be tried as soon as vision is compatible with fusion. Current opinion places this vision at about 6/12. At the Clinic, however, we have a record of one case in which fusion was perfect, in which stereopsis was present, and in which vision was 6/15. As a preliminary to operation, all agree that, when feasible, fusion training is essential. This is the period in which

orthoptics has been of most value to me. It is then that the eyes are being studied for differentiation and classification of the defects. Orthoptics aids in establishing relationships, such as muscular, innervational, fusional, emotional, and sociologic. The ability to possess simultaneous perception, corresponding retinal congruity, and some degree of fusion certainly insures a much brighter outlook for successful surgery. After operation has been performed, the ensuing stage of muscular disorganization, during which so frequently the patient is dismissed, would seem to be the time preëminently suited for the employment of orthoptic training. Above all others, it is probably the time when there is the best chance of restoring normal function and ultimately bringing about a real cure.

False projection runs high in cases of alternating strabismus. Pugh<sup>12</sup> found it in 77 percent of cases, but in my experience this seems rather high. Alternating strabismus with false projection is, however, the least amenable to any form of treatment. The argument against straightening alternating strabismus with false projection surgically is, of course, that persistent diplopia may result following operation. In our experience at the Clinic, alternating strabismus has been amenable, as a rule, both to training and surgery. I have encountered temporary diplopia, lasting from a few days to several weeks, in many cases after operation. Except in two instances, however, the diplopia finally disappeared and the result was satisfactory. It seems probable that, when alternating strabismus with false projection is corrected surgically, one of several things may occur: (1) there may be true projection and fusion at once, although this seems rather uncommon; (2) there may be a period of disorganization, with gradual adjustment to some degree

of fusion; (3) there may be a condition of pseudobinocularism, or alternate suppression, which is probably the most common occurrence; and (4) there may be a continuation of the false projection with persistence of the diplopia. I believe this last occurs rarely. If more patients with alternating strabismus were intensively trained after operation, the result might be surprisingly good.

Although discussion of the surgical procedures is not within the scope of this paper, I<sup>3</sup> expressed the point of view in a former paper that possibly the best surgical results might be obtained after a very careful and refined differential diagnosis has been made, with selection from all the various surgical procedures of that combination best fitted for the patient at hand. Orthoptic training helps in this selective process.

In a comparison of the results of orthoptic training and operation in the treatment of strabismus, it would appear that one is as important as the other, and if to these forms of treatment accurate refraction is added, three weapons will be at hand for the combating of strabismus. It is difficult, indeed, to say which of the

three is the most indispensable. The maximal results should be obtained through the combined use of all of them, if properly performed and in correct sequence. Operation rarely should be performed before refraction and orthoptic training have been given a reasonable trial. On the other hand, one should not attempt to carry training past the point at which it loses its effectiveness. When there are indications for surgical treatment, operation should be performed at once, regardless of the age of the patient.

#### SUMMARY

Restoration of function seems to be the dominant purpose in the treatment of strabismus, and the connecting link between cosmetic surgery and restoration of normal function appears to be orthoptic training.

Accurate refraction, intensive orthoptic training, and selective surgery are the means at hand for the combating of strabismus. All are of equal importance, and maximal results should be obtained through the combined use of all in proper sequence.

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### DISCUSSION

MARJORIE V. ENOS (New York): It is a privilege to discuss the paper of a man with such great experience who can so briefly and clearly present his ideas on so controversial a subject as "The relation of orthoptic treatment to surgery."

I find myself in general agreement with Dr. Prangen's conclusions, though would like to say that we orthoptic technicians in general are more hopeful about anomalous correspondence; it may mean much long and hard work but we do have cases that are broken down.

I should like to be allowed to consider some of the problems that arise in the work of the orthoptic technician particularly when a decision regarding surgery is necessary.

The question of when to operate in a case of squint is a matter requiring good judgment, and the duty of the technician is to furnish data on the patient's angle of squint under varying conditions; the action of the muscles in the six cardinal positions of gaze; the presence or absence of abnormal correspondence; and the state of the binocular functioning of the eyes.

First and foremost, an experienced technician who has worked with a patient the length of time agreed on with the oculist has the right to say that orthoptics probably can do no more—at least until an operation is performed. The discouraging thing is the way in which most parents prefer to do almost anything in order to avoid an operation. Do not think I mean that every case should have an operation, but it does help to work with an oculist who is will-

ing to operate after a reasonable time has been spent with orthoptic training.

We technicians stand today at the crossroads in the profession of orthoptics (if I may stretch a point to call it that), wondering if the end of this war will bring new opportunities for research and advancement, or if the whole situation will so lower our standards of living that orthoptics will become a luxury we Americans cannot afford. Those who feel that surgery alone will take care of the squints, and with much less fuss and bother, too, do not need to worry, but those who have seen good results want to see those efforts continued. Our oculists who have grasped the importance of a correct diagnosis and the necessity of establishing binocular vision as a criterion to be used in operative technique, feel that orthoptics will continue and may eventually become a science in the best meaning of the term. I did a lot of long hard thinking before deciding to study orthoptics because I had worked in the eye field previously and knew the prejudice against it in many quarters. I did not want to go into a field which might be declared a mistake 10 years later. I sometimes feel that the unintentional offenders are those who claim brilliant success with very high percentages of cures, because they are not believed by the skeptics, and the effect of much good work is lost to the profession in general. I am afraid we (oculists and technicians alike) fail to make clear that most statistics are on selected cases and do not record the patients who are ruled out from the beginning because they have an amblyopia which cannot be improved, an abnormal correspondence which can-



not be broken down, or an uncoöperative parent. I feel this is a natural error into which all professions fall, as the normal desire is unconsciously to make out the best case possible for one's pet theory. I would like to see a list of the 50 worst cases that an office or clinic has had with some possible explanation of the reasons; for it is by our failures that we learn. We all have them I know, as we see each others' dissatisfied cases much more often than we see each others' successes.

In diagnosis an instrument which from the very beginning breaks up every natural effort to maintain fusion is necessary, as we want to bring out the total amount of squint, but it seems to me that a distinction should be drawn between diagnostic instruments to be used when surgery is being considered, and instruments to be used when we are encouraging all the patient's natural eye habits (assuming they are good ones). For a good diagnosis both types are necessary. I have seen children go into a spasm the minute a red and green glass is put on their eye, when in normal seeing they do a very good job of holding their eyes straight.

A good technician is the interpreter to the patient of the oculist's aims and wishes in each case, the average oculist not having the time to sit down and patiently answer the anxious parent's questions—"How long will the exercises last?" "If we have an operation will more exercises be necessary?" then when they run out of that type, it is "What's that lens you are using? Oh, a prism, well what does that do, magnify?"—then we go into an elementary course of optics, because unless the parent either has complete unquestioning faith or understands what is being done, orthoptics cannot be attempted.

The decision regarding surgery is essentially that of the oculist, but the technician cannot help but love the little "twerps" of which she sees so much, and if at times she becomes a bit vehement in the support of what she feels is best for the child, I know the oculist can smile and accept the sincerity and interest of the technician, without becoming offended and feeling that she is telling him how to do something he really knows better himself.

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## CYLINDER RETINOSCOPY—SIMPLIFIED\*

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Cylinder retinoscopy was introduced into the United States by Dr. Edward Jackson almost 50 years ago.<sup>†</sup> It must be said, however, that Dr. Jackson's exposition of the method was rather sketchy and incomplete. It would have required a good deal of digging to learn cylinder retinoscopy from the meager description given. Perhaps for this reason, possibly for other reasons, also, the knowledge of cylinder retinoscopy did not become widely distributed in the United States. In fact, it was hardly known to the vast majority of practitioners. But about 1920 Prof. Karl Lindner of Vienna followed by Dr. Kramer of Vienna revived the method, expanded, refined, and developed it. In fact, they went to the other extreme of overdeveloping and overrefining it. I plead guilty myself to such overrefinements of the method in some of my own contributions on the subject. This newly developed method has spread to some extent in Continental Europe, but is still relatively unknown in the United States. Now, one can strike a middle course between the sketchiness of the original and the overelaboration which followed, and it would be well if the practitioner were familiar with cylinder retinoscopy whether he chooses to use it often or occasionally, or not at all.

What is cylinder retinoscopy? The name by contrast suggests the term sphere retinoscopy for the ordinary method in common use. By this method spheres are

introduced to neutralize spherical errors and also to neutralize astigmatic errors. This is done by using a sphere to neutralize each of the principal meridians and taking the difference for the cylinder. This system is taught in most ophthalmologic postgraduate courses; the findings are jotted down on the two limbs of a right angle. Cylinder retinoscopy does not imply that only after a sphere has been used to neutralize one meridian, is a cylinder introduced to neutralize the other meridian. In addition it means that in placing the neutralizing cylinder use is made of the special phenomena incident to obliquely crossed cylinders in order to determine the axis and the power of the correct cylinder. It is the latter feature, the utilization of the special properties of obliquely crossed cylinders, which makes cylinder retinoscopy a specialized method. To follow up the procedure most easily, two or three preliminary points should first be considered.

The "with" and "against" movements in retinoscopy are well known. They are basic. In addition to these two types of movement there are two others that are conveniently termed, "corresponding" movements and "oblique" movements. Corresponding movements are those in which the reflex, using the term reflex for the combined light and shadow in the pupil, moves in the same plane or along the same meridian as the mirror, with or against. If the mirror is rotated along the horizontal meridian the reflex moves in the horizontal meridian. If the mirror is rotated along the 45-degree meridian the reflex moves along the 45-degree meridian, and so on. Oblique movements are those in which the reflex moves

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† Jackson, Edward. Skiascopy and its practical application to the study of refraction. Philadelphia, The Edwards and Docker Co., 1895, p. 81 and pp. 83-84.

obliquely to the rotation of the mirror. To illustrate: If the mirror is rotated along the horizontal meridian, the reflex movement seems to slant off—for example, along the 45-degree meridian—or if the mirror is rotated along the 45-degree meridian the reflex movement seems to slant off, say, along the horizontal meridian, and so on.

In spherical errors the reflex movements always correspond to the mirror movements. In astigmatic errors, the reflex movements correspond to the mirror movements only when these are made along the two principal meridians. In all other meridians the reflex movements are oblique to the mirror movements. This phenomenon may be regarded as a sign of the presence of astigmatism. Now an oblique movement is not so marked or pronounced as a corresponding movement, probably because the oblique movement is merely apparent. The real movement of the retinal light spot is always in the same meridian along which the mirror movements are made. To make an oblique movement more distinct, the mirror is rotated so that the reflex moves in the same meridian as the mirror rotation. For example, if, as the mirror is rotated along the horizontal meridian, the reflex movement seems to slide off to around 45 degrees, the mirror movement is best made along the 45-degree meridian, when the reflex movement will become more pronounced. For this reason the term oblique movements is used also in another sense. If there is a cylinder in the trial frame—for example, a plus 1.00D. cyl. ax. 90°—and the mirror movement along the 180-degree meridian shows a “with” movement which slants off, say, toward the 30-degree meridian, the mirror rotation is made along the 30-degree meridian, when the “with” movement will become more pronounced and will now correspond to the mirror

movement. But the movement is termed “oblique” because it is oblique to the axis of the inserted cylinder; here both the mirror movement and the reflex movement, although they correspond to each other, are oblique to the axis of the inserted cylinder.

Another preliminary point to examine is the significance of the so-called light-band. Suppose an eye shows a “with” movement in all meridians, and a plus sphere—for example a +2.00D. sph.—neutralizes the vertical or near vertical meridian. There will be a “with” movement in the horizontal meridian which may be termed the “*with-moving* meridian.” But the reflex which moves “with,” will be more or less band-shaped and run along the vertical meridian. This may be called the “with-band.” It is at right angles to the “with-moving meridian.” Or suppose the eye shows an “against” movement in all meridians and a minus sphere—for example, a -2.00D. sph.—neutralizes the horizontal meridian. There will still be an “against” movement in the vertical meridian, and this may be termed the “*against-moving* meridian.” The reflex which moves “against” is more or less band-shaped, running along the horizontal meridian. This is the direction of the “against-band,” which is at right angles to the “against-moving meridian.” The band shape may be marked or barely indicated, but it is convenient to use the term and know its location with reference to the axis of the inserted cylinder.

The aforementioned points in the procedure of cylinder retinoscopy can best be incorporated by means of an illustration. An eye, for example, shows a “with” movement in all directions. Starting with a plus sphere, neutralize the less hyperopic meridian, which is usually the vertical—for example, with a +2.00D. sphere. There remains a “with” movement along the horizontal meridian. In

the vertical or near vertical meridian there is a "with-band," and in the horizontal or near horizontal the "with" movement. A plus cylinder—for example, a 1.00D. cylinder—is placed with its axis along the "with band" and the mirror is rotated along the horizontal meridian. If there is no movement or a corresponding movement the cylinder axis is right and the cylinder strength is changed in order to neutralize the horizontal meridian. But suppose, as the mirror is rotated along the horizontal meridian, the reflex movement slants off and shows a "with" movement somewhere along the 45-degree meridian. This oblique "with" movement becomes more marked as the mirror is rotated along the approximately 45-degree meridian. Coincident with this oblique "with" movement somewhere along 45 degrees there is a "with-band" somewhere along 135 degrees. Both these phenomena, the oblique "with" movement and the oblique "with-band," show that the cylinder axis is incorrect. To set it correctly the plus cylinder axis is turned *toward* the "with-band." It is, for example, turned 10 degrees so that the +1.00D. cylinder is at axis 100°. The mirror is now rotated along the 10-degree meridian, as near as it is possible to do so, and suppose now a "with" movement appears somewhere along the 135-degree meridian, associated with a "with-band" somewhere along the 45-degree meridian. The plus cylinder has to be turned again *toward* the "with-band," perhaps 5 degrees, setting it at axis 95 degrees. Mirror movements across the horizontal meridian would most likely show a slight "with" movement corresponding to the mirror. The cylinder axis is correct. A stronger plus cylinder is necessary to neutralize the remaining "with" movement.

Now, coincident with the "with-moving meridian" and the "with-band," there is also an "against-moving meridian" and

an "against-band." But in using plus cylinders it is best to concentrate only on the "with" movement and the "with-band." The "with" movement and the "with-band" are generally easier to see and locate than the "against" movement and the "against-band," probably because, for one thing, the "with" movement (when a plane mirror is used) is the true movement, whereas the "against" movement is, in a sense, an illusion. The essential point to remember then is to watch for the appearance of a "with" movement or a "with-band" about 45 degrees to either side of the plus cylinder axis. The appearance of such a band shows the cylinder is wrongly placed, and to set it right the axis has to be turned toward the "with-band."

It is possible to examine all eyes with plus cylinders, and many examiners prefer to do so routinely even in myopia—under cycloplegia, of course. However, there are also many who use minus cylinders. The compact trial cases such as the "Refractors" and the "Phoroptors" carry only minus cylinders; in some subjective tests, moreover, minus cylinders are preferable. The procedure will therefore be repeated with the application of minus cylinders. If an eye shows an "against" movement in all directions, a minus sphere—for example, a -2.00D. sph.—neutralizes one meridian, usually the horizontal meridian first. There is then an "against" movement in the vertical meridian and an "against-band" in the horizontal meridian. A minus cylinder—for example, a -1.00D. cylinder—is placed at axis 180 degrees (that is, along the band) and the mirror is rotated along the vertical meridian. There may be no movement now or a corresponding movement. This shows that the cylinder axis is correct. But suppose as the mirror is moved along the vertical meridian the "against" movement which was previ-

ously in the vertical meridian seems to slant off toward the 135-degree meridian and the "against-band" appears somewhere along the 45-degree meridian. This shows that the minus cylinder axis is incorrect and to set it correctly the minus cylinder axis has to be turned *toward* the "against-band." The axis of the  $-1.00D.$  cyl. is shifted from 180 degrees to 10 degrees and the procedure repeated. Of course here, too, coincident with the oblique "against" movement and the "against-band" there is a "with" movement and a "with-band." The "with" movement is in the direction of the "against-band," and the "with-band" is in the direction of the "against" movement. It is also possible to make the "with" movement and the "with-band" the more prominent by using overstrong minus cylinders. But it is better in the interests of simplicity, when using minus cylinders, to concentrate chiefly on the "against-band" and the "against" movement, in order to set the cylinder aright.

The strength of the initial cylinder depends upon several factors, such as the brightness of the reflex, the rapidity of movement, and the character of the band. When the last named is well marked, the error is  $2.00D.$  or more and one can start with a  $2.00D.$  cylinder. If the band character is not well marked, the error is under  $2.00D.$  The findings of the ophthalmometer, which are best obtained before retinoscopy, will also help. The important point is to use a cylinder slightly weaker than the full correction. In this way if one uses plus cylinders to neutralize a remaining "with" motion in one meridian, one concentrates on the oblique "with" movement and the "with-band" which will be the more prominent, and turns the plus cylinder axis toward the "with-band." Similarly, if minus cylinders are used to neutralize a remaining "against" movement in one meridian, con-

centrate on the oblique "against" movement and the "against-band," which will be the more prominent, and turn the minus cylinder toward the "against-band." In either case it is best to start with a weaker cylinder and build up if necessary.

A few words about the so called "guide angle." This is the name of the angle between the axis of the plus cylinder and the direction of the "with-band," or the axis of the minus cylinder and the direction of the "against-band." It is called guide angle because the examiner can guide himself by the size of the angle as to whether the cylinder, though in the wrong position, is just right in amount, too weak, or too strong. The size of the angle varies from the limits of 0 degrees to 90 degrees. It tends to be below 45 degrees when the cylinder is too weak, a little above 45 degrees when the cylinder is just right, and much above 45 degrees when the cylinder is too strong. It is probably better not to consider the size of this angle but just to watch for the *presence* of such an angle. It indicates that the cylinder axis is wrong. For moderately small misplacements of the cylinder when using a cylinder a little weaker than the full cylinder power, the guide angle will be close to 45 degrees; that is, the band will appear about 45 degrees to either side of the cylinder axis. Once the correct cylinder axis is found, the amount may be determined more easily by ordinary retinoscopy, watching for the point of neutralization or slight reversal.

A few practical suggestions: Cylinder retinoscopy requires a keen eye and a steady hand. The pupil must be dilated and the examination made along the patient's visual axis or very close to it; for example, with the patient fixating the upper edge of the mirror. It is also necessary to have the cylinder axis so marked

that it is visible from the distance of the examiner. This may be accomplished by having the handle of the rim in line with the axis or preferably by markings on the surface of the lens. Some arrangement with Thorington's "axonoscope" may also be applied. It is also important to have one meridian neutralized as accurately as possible with a sphere before cylinders are applied to neutralize the other meridians.

Perhaps even more than in ordinary retinoscopy, the aberrations of the eye complicate the test. The fact that the refraction of the peripheral zone is variable along different directions and differs, as a whole, from the refraction of the optical zone, also complicates the test. Nevertheless, any one who has followed the procedure herewith presented should find it relatively easy to try out its application.  
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## EVALUATION OF ORTHOPTIC INSTRUMENTS

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The number of orthoptic instruments is legion. They range in complexity from the simple bar reader to the extreme elaborations of the royal roscope. Fantastic claims as to their individual efficacy have been set forth too often, particularly by the manufacturers. So far as I know, no comparative, scientifically controlled study has ever been made. Such a piece of research would be a valuable contribution to orthoptics.

Certain practical applications do become established, however, as the result of use over a period of time. The evaluations set forth in this paper are based on such experience. Admittedly, they may not be entirely free from bias.

Any instrument that can be used for the treatment of squints can also be used for the treatment of phorias, but the converse is not true, since the orthoptic treatment of strabismus presents more problems and complications than does that of the latent muscle imbalances.

At present, the major amblyoscopes, the stereoorthopter, and the roscope are used more than any others as basic instruments in orthoptic training. For this reason, I propose to limit this discussion chiefly to them.

Of these, the major amblyoscopes are the preferred instruments. They comprise the synoptophore, the synoptoscope, and the orthoptoscope. As they are made by different manufacturers, they differ in minor details, but the optical principle on which they are constructed is that of the original Worth amblyoscope. The incorporation of an illuminating system with individual flashers and rheostats for each light, the mounting of the arms or barrels so that they can be moved independently as well as in unison, and the inclusion of accurately calibrated scales are improvements common to all, which greatly enhance their value.

It is essential in working with squints that the instrument used be capable of adjustment to the angle of deviation, so that images can be projected simultaneously on the two maculas. The major amblyoscopes have a wide lateral range and can compensate for more than 100° of deviation in either direction (convergence or divergence). This range likewise permits the development of wide fusion amplitudes. Adjustments can also be made for vertical and torsional disturbances.

In the last few years, emphasis has

been placed on the fact that an abnormal retinal correspondence is apt to develop in squinters as the result of the faulty position of the eyes. Authorities are agreed that 50 percent or more of all individuals with strabismus develop this anomalous association. Accordingly, the diagnosis, and treatment of abnormal retinal correspondence have become paramount functions of orthoptics.

The chief reason for the preference for the major amblyoscopes lies in the fact that they qualify for both these functions. I believe that the orthoptic technicians present will agree with the statement that the diagnosis of the status of retinal correspondence can be made more satisfactorily on one of the major amblyoscopes than by any other means. This statement is indisputably true in the case of very young children (three to six years).

Observation of the behavior of the sharp corneal reflexes with alternate flashing enables the examiner to check objectively against the subjective setting of the patient as well as to obtain an independent measurement.

In regard to treatment, these instruments are the only ones with proved techniques for overcoming anomalous retinal correspondence. Several techniques based on stimulating the two maculas, either simultaneously or in rapid succession are available. At best, the procedure is time consuming, and many treatments may be required before the objective and subjective measurements invariably coincide, indicating the establishment of normal retinal correspondence.

Noting the behavior of the corneal reflexes is also an invaluable aid when fusion amplitude is being developed in individuals with normal retinal correspondence. The alert observer often notes the point where fusion is lost before the patient becomes aware of diplopia. Encouragement or confirmation of suppres-

sion is thereby guarded against.

Viewing the corneal reflexes may be facilitated by removing the patient's glasses and substituting the equivalent spherical correction with lenses from the trial case in the cells attached to the eye pieces. In the treatment of accommodative squint, a condition in which it is desirable to disassociate accommodation and convergence, the strength of plus lenses can be reduced or minus lenses used to introduce the desired amount of accommodation.

It might be noted here that no provision is made on the stereorthopter or rotoscope for conducting exercises with varying amounts of accommodation. The collimating lenses can be removed from the stereorthopter in order to introduce a fixed amount of accommodation, and the rotoscope is equipped with a pair of  $-2.50$  spherical lenses that can be fitted in front of its fixed lenses.

The mounting of the arms of the major amblyoscopes so that they can be moved horizontally, either independently or together, provides for measurements and fusion amplitudes in the lateral fields of regard. There is no provision, however, for these functions in the vertical fields, and this may be considered the main deficiency of these instruments.

Before going on to the other instruments, I want to take up the question of targets. This involves more than the mere provision of fixation objects grouped according to Worth's three grades of binocular vision. In the orthoptic treatment of young children, aside from the personality of the squint trainer, the major burden of obtaining coöperation and maintaining attention falls on the targets used. *No orthoptic instrument will cure any form of muscular imbalance if the patient looks with indifference.* It is essential that he must recognize and be interested in what he is looking at.

Targets for the major amblyoscopes meet this need in depicting such subjects as animals, toys, games, nursery rhymes, and Walt Disney characters. Along with other more abstract representations a large supply in varying degrees of difficulty is on the market. Furthermore, with a little thought and care it is possible to supplement one's commercial supply with others made by hand. Targets relating to Christmas, St. Valentine's Day, Easter, and so on, can be reserved to furnish new interest as the various holidays and seasons roll around.

Emphasis should be placed on the fact that most of the targets for the major amblyoscopes are brightly colored, with the colors enhanced in the instruments by transillumination. Psychologists have stressed the attention-arresting and attention-holding power of color when applied to advertising. It is an equally potent factor in these respects when applied to orthoptics.

In contrast, the targets supplied for the other two instruments I am going to consider, the stereorthopter and the roto-scope, are in black and white, with a preponderance of representations too abstract to have meaning or appeal for a young child. While this is not an intrinsic fault of the instruments themselves, it is one which can greatly curtail their usefulness.

It is a fairly simple matter to supplement the commercial targets of the standard roto-scope with colored pictures pasted on 30- by 75-mm. cards. This deficiency cannot be so easily compensated for with the royal roto-scope or the stereorthopter, in which the targets must fit in circular holders and be made of a material capable of transillumination.

The stereorthopter resembles the amblyoscopes in that images are reflected to the eyes from mirrors set at an angle. It differs in that the targets remain stationary as the mirrors, which are hinged

together, are adjusted to give the desired prismatic effect. By so changing the angle of the mirrors a range approximating  $60^\Delta$  of divergence to  $70^\Delta$  of convergence can be covered. Like the major amblyoscopes, provision is made for vertical and torsional disturbances, the targets are transilluminated, and rheostats and flashers are connected with the individual lights.

The yoking of the mirrors deprives the stereorthopter of much of the flexibility of the major amblyoscopes, and their manipulation by means of a short lever permits less delicate control. Furthermore, it is not so precisely calibrated. It is a cumbersome instrument and its massiveness sets up a barrier between the patient and the doctor or technician, a definite handicap in working with young children.

The eyes of the patient are visible, however, and the corneal reflexes distinct enough to facilitate the obtaining of a satisfactory objective measurement by alternate flashing, with which to compare the subjective report of the patient. It is possible, then, to diagnose abnormal retinal correspondence on the stereorthopter. Theoretically, it should also be possible to treat and correct the anomaly on this instrument, but its usefulness for this function has not yet been established.

The distinctive feature of the stereorthopter is the gearing of the mirrors to a motor which oscillates them horizontally when it is set in motion, thus requiring the maintaining of binocular vision in the lateral fields, an excellent exercise for individuals with a slight noncomitant deviation. Furthermore, settings can be made so that the angle of the mirrors changes as they swing, in order to introduce a varying prismatic effect which requires movements of convergence or divergence in conjunction with the lateral movements. Exercises of this sort are helpful in developing fusion amplitudes,



particularly so in building up convergence.

It should be noted that flashing devices are hooked up with the motor as well, so that the lights can be flashed automatically either singly, together, or alternately if such stimulation is desired.

One of the selling points often advanced for instruments with motorized units, such as the stereorthopter and the rotoscope, is the contention that the patient can be exercised automatically after the proper preliminary adjustments have been made, thus leaving the doctor or technician free for other duties. While this argument may be valid for those adults and adolescents eager to improve their condition, it is absolutely fallacious when applied to other individuals, especially to young children. The child is easily distracted and much more interested in what the other fellow is doing than in what he is supposed to do. Unless the eye of authority is on him, he will not continue to look attentively. He begins to play with various parts of the instrument. This may involve a physical hazard where rotating parts are exposed, as on the rotoscope, and straying fingers may be pinched. Another precaution must also be observed with these mechanized exercises. In following moving targets patients may become nauseated or dizzy, and care must be taken that the treatments are not prolonged to the point where this unpleasant reaction occurs.

Two models of the rotoscope, as has been indicated, are on the market, one a standard model, the other known as the royal rotoscope. I have had no experience with the latter model, but it is my impression from having seen it demonstrated that its superelaborations do not compensate for the marked increase in cost.

Optically, the rotoscope is a Holmes or Brewster stereoscope with increased prismatic power. Even so, it is limited in

its adjustments, by separating the targets, to 50<sup>A</sup> of convergence and 40<sup>A</sup> of divergence. The advantage of increasing the strength of the prisms still more would undoubtedly be offset by increased chromatic aberration and distortion, as these are sufficiently evident in the present set-up to be disturbing.

The rotoscope is limited not only to the treatment of deviations ranging from 50<sup>A</sup> of convergence to 40<sup>A</sup> of divergence but it is further limited to cases in which there is normal retinal correspondence. The eyes of the patient are visible through the lenses, but not with sufficient clarity in most instances to obtain an accurate objective measurement. It is often impossible to observe any shift in fixation with alternate screening or flashing over a wide range of settings. For this reason, the status of retinal correspondence cannot be determined satisfactorily or appropriate treatments instituted for the correction of abnormal retinal correspondence. Before binocular treatments are given on the rotoscope to any squinting individuals, the status of retinal correspondence should first be determined by the Tschermak afterimage test, or by a diplopia test, if a major amblyoscope is not available, in order to eliminate those individuals who manifest the abnormal association.

The characteristic feature of the rotoscope, implied in its name, is its provision for revolving the test objects. The flat plate on which the targets are mounted, and over which they are moved in and out, is geared to a motor which revolves it. Speed and diameter of revolutions can be varied, with 72 mm. as the maximum diameter.

Following the rotating targets and maintaining fusion call into play constantly changing ocular-muscle coördinations. Fusion must be held in all the secondary fields of regard, and individuals

with vertical deviations have difficulty in so doing. Exercises of this sort on the rotoscope are especially beneficial for individuals with vertical imbalances, whether hyperphorias or hypertropias. These rotational exercises may also aid patients with lateral deviations in transferring their acquired fusional ability to daily life, where the demands of useful binocular vision call for facile adjustments in various directions of gaze as well as for different distances.

Stimulation by flashing, as an adjunct in breaking down amblyopia and suppression, can automatically be given on the rotoscope, as its lights like those of the stereoorhtopter, are in circuit with the motor.

#### SUMMARY

In the foregoing discussion, emphasis has been placed on the usefulness of the orthoptic instruments in the treatment of squints, particularly in the treatment of young children suffering with squints, for it is my conviction that the orthoptic treatment of young children offers both the greatest challenge and the greatest opportunity for developing useful binocular vision.

Of all the orthoptic instruments on the market, the major amblyoscopes (the synoptophore, the synoptiscope, and the

orthoptoscope) are the preferred instruments. They afford the most satisfactory means of diagnosing the status of retinal correspondence, and, in the presence of abnormal retinal correspondence, they offer the only proved methods of treatment. Furthermore, they are adapted for the treatment of any form of ocular-muscle imbalance for which exercises may be prescribed. Fusion can be exercised out of the primary position in the lateral fields, but not in the vertical fields of regard.

The mechanism of the stereoorhtopter facilitates the development of fusion amplitudes, particularly of convergence, and in the presence of a slight noncomitance, of fusion in the lateral fields. The presence of abnormal retinal correspondence can be determined by means of the stereoorhtopter, but its usefulness in treating this condition has not yet been established.

The rotoscope is limited in the treatment of lateral deviations to those ranging from 50<sup>Δ</sup> of convergence to 40<sup>Δ</sup> of divergence, and in the case of squints to those in which there is normal retinal correspondence. The rotating targets, requiring fusion to be maintained in the various fields of regard, afford a particularly effective exercise for vertical disturbances.

*30 East Fortieth Street.*

# NOTES, CASES, INSTRUMENTS

## DISCISSION OF CONGENITAL (CATARACTOUS) DIS-LOCATED LENS

OTIS R. WOLFE, M.D., RUSSELL M. WOLFE, M.D.\* AND PIERRE GEORGARIOU, M.D.  
*Marshalltown, Iowa*

In May, 1942, W. L., a highly intelligent boy, aged six years, was brought to us with vision, R.E. 4/200; and L.E. 6/200, which could be only slightly improved by dilatation and refraction. A positive diagnosis of congenitally dislocated (opaque) lenses was made, as indicated in figure 1. A discession of the

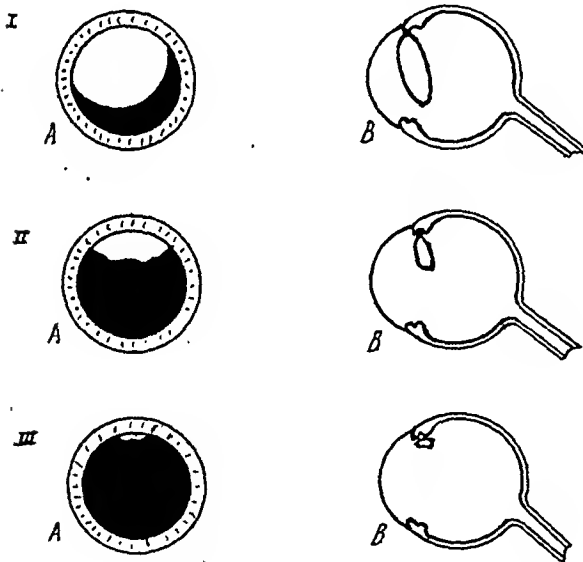


Fig. 1 (Wolfe, Wolfe, and Georgariou). A, Appearance of right eye, with congenital dislocation of (cataractous) lens, on first examination. Full atropine dilatation: B, Schematic drawing of position of lens.

Fig. 2. A, One month after second two-knife discession. The left eye had only one surgical procedure and less lens remaining after one month. B, Schematic drawing of relative size and position of lens residue.

Fig. 3. A, Appearance of both eyes nine months after surgery was employed. Normal corrected vision. B, Schematic drawing of relative size and position of lens residue.

\* Lieutenant U.S.N.R. (Ophth.).

lens of the right eye was performed by the following technique: First the lens was speared with a straight needle (fig. 4) and the lens lifted forward and downward. Then a curved needle was inserted at the

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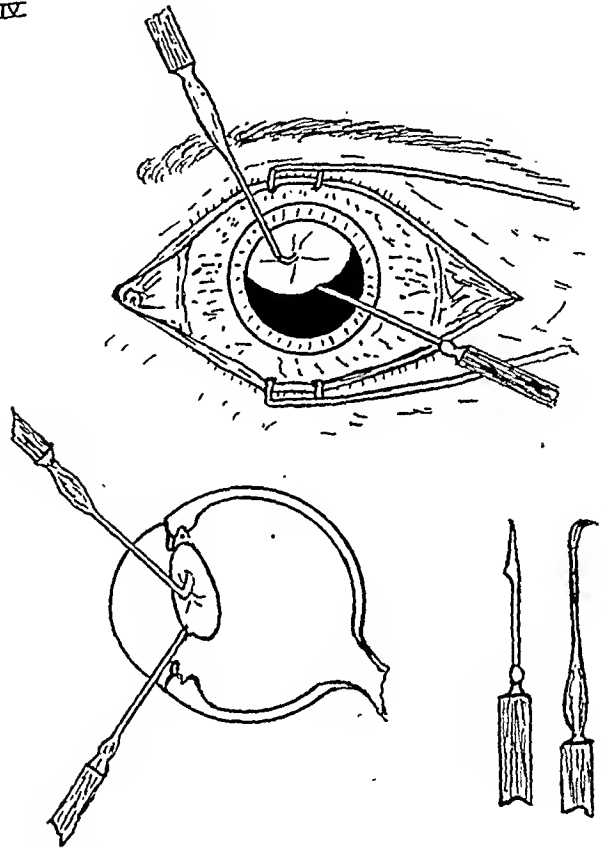


Fig. 4 (Wolfe, Wolfe, and Georgariou). The straight needle entered the anterior chamber at the limbus (4-o'clock position). The lens was speared and lifted forward and down. A curved needle then entered the anterior chamber at the limbus (9-o'clock position), and slit the lens crosswise while the lens was held and steadied by the straight needle.

opposite limbus, engaged in the lens, and a cross discession performed. This was repeated about one month later. Atropine dilatation was continued, only a very mild operative hyperemia resulting.

In July, 1942, the same surgical procedure was employed on the left eye. Figure 2A, with 2B representing the schematic drawing, serves to illustrate the

appearance of the eyes in September, 1942. In December, 1942, the condition of the eyes was as shown in figures 3A and 3B (schematic), representing the material progress. At the last examination, with the patient looking straight ahead, no lens tissue whatever was seen. With the eye looking upward a small remnant can be found, as depicted in figure 3A.

The last examination was made on April 8, 1943, when the vision, corrected (R. = +14.00D. sph.  $\approx$  +2.00D. cyl. ax. 90°; L. = +13.50D. sph.  $\approx$  +2.00 D. cyl. ax. 90°), was 20/15 in both eyes. Bifocals are now being worn and contact lenses will be considered later. The patient has, during this time, been undergoing intensive orthoptic training. To all appearances the eye is now normal in every respect, except aphakia, and the patient was permitted to take up his school work and studies which had been discontinued during the treatment. It now appears to be an ideal case of rehabilitation. Two other children have been so operated on with the same degree of success.

From this limited experience the authors suggest that possibly these cases of congenital dislocations stand a better chance of a return to near normal vision by early surgery than would be the case if they were allowed to go on to adult life with impaired vision, lack of retinal education, and later be subjected to much more difficult surgery when the lens becomes hard.

*Wolfe Cataract Clinic.*

## EXOPHTHALMOS IN THE NEWBORN

### REPORT OF A CASE

ROBISON D. HARLEY, CAPTAIN  
(MC), A.U.S.

*Panama, Canal Zone*

The occurrence of unilateral exophthalmos in the newborn infant is unusual.

In a consideration of the causes of proptosis in the infant, we should include (1) birth injuries from the use of obstetrical forceps, when severe pressure may be made over the malleable bones of the face so as to compress the orbital contents; (2) retrobulbar hemorrhage including infantile scurvy; (3) orbital cellulitis; (4) congenital vascular tumors; (5) dermoids and malignant tumors; (6)



Fig. 1 (Harley). Exophthalmos in a newborn infant, 11 days old. Complete closure of the lids of the left eye was present only when the infant cried.

Fig. 2 (Harley). Complete recession of the exophthalmos in a newborn infant, aged 32 days. Note edema of the left upper lid, which disappeared a few days later.

cranial sinus thrombosis; (7) meningocele and orbital abscess; (8) inflammatory pseudotumor of the orbit; (9) the Schüller-Christian syndrome; (10) syphilis and tuberculosis; and (11) parasitic diseases.

The pre- and postnatal history of the infant, the delivery, blood studies including the serology and vitamin-C content, X-ray studies, and a general physical examination should serve to exclude the majority of the differential conditions. Windham<sup>1</sup> reported a case of exophthalmos in a six-day-old infant which promptly subsided within 20 days following X-ray therapy. No definite diagnosis could be made. The following case report has a marked similarity to the one just cited.

D. S., a brown female infant, three days old, was brought to Gorgas Hospital on April 25, 1942, because of a marked

exophthalmos of the left eye. The mother stated that the infant's eyes were perfectly normal following birth but that on the first day after birth the left eye began to protrude noticeably. The mother had been in regular attendance at the Gorgas prenatal clinic, but was delivered in her home at the last minute by a midwife, due to the distance from the Hospital. The delivery was reported to have been normal, as had been two previous ones in 1936 and 1940. The prenatal record was normal in every respect. The mother's Wassermann test was negative and there was an adequate intake of citrus fruits in her well-rounded diet.

A complete physical examination by the pediatrician revealed a normal healthy infant except for the prominent left exophthalmos. Laboratory examinations including blood studies and serology were all normal. On April 27th the patient was seen at the Eye Clinic, where the intraocular tension, pupillary reflexes, extraocular motility, and fundi were found to be within normal limits. No exophthalmometer was available, but by measuring the summit of the cornea from the outer margin of the orbit, it was found to be O.D. 6 mm. and O.S. 17 mm. There was no ecchymosis nor inflammation about the lids, but an incomplete closure of the eyelids on the left side was noted. No bruit or pulsation of the eye could be demonstrated. Two X-ray pictures of the skull, orbits, and optic foramina were

taken and reported negative. The infant was seen in the Eye Clinic every two days until May 5th. The proptosis measured the same but lid closure appeared increasingly more difficult. Because of the danger of desiccation to the cornea, the mother was instructed to use boric-acid drops every 15 minutes and report back in one week. A diagnosis of orbital hemorrhage probably subperiosteal was made at this time, although there was no evidence of scurvy. The infant was returned to the Clinic on May 15th, and the mother requested more drops since "they had apparently made the baby's eye well." The proptosis now measured O.D. 6 mm., O.S. 8 mm. The mother stated that the exophthalmos had subsided within the past few days. The infant was seen again on May 24th, at which time both eyes measured 6 mm., just 32 days since the proptosis had first been noted. Four months later the eyes were still perfectly normal.

*Comment.* In view of the normal general physical examination, the normal laboratory and roentgenographic studies, and the rather prompt recession of the unilateral proptosis in this case, it would appear that we were dealing with a case of orbital hemorrhage probably subperiosteal. The lack of evidence for scurvy strongly suggests birth trauma as the most likely etiology. The question of any amelioration in this case from two exposures to the X ray is a debatable point.

*Gorgas Hospital.*

#### REFERENCE

- <sup>1</sup> Windham, R. E. A case of exophthalmos in a newborn infant. *Amer. Jour. Ophth.*, 1942, v. 25, Oct., p. 1236.

# SOCIETY PROCEEDINGS

EDITED BY DR. RALPH H. MILLER

## NEW YORK SOCIETY FOR CLINICAL OPHTHALMOLOGY

May 4, 1942

DR. JAMES W. SMITH, *presiding*

### CLINICAL VARIETIES OF NYSTAGMUS AND THEIR INTERPRETATION

DR. ALFRED KESTENBAUM spoke on this subject during the instructional hour.

### RECENT ADVANCES IN CATARACT SURGERY

DR. DANIEL KIRBY presented a paper dealing with advances and points based on results in cataract surgery. He stressed the fact that extracapsular delivery is indicated in many cases and will produce better results when properly employed than intracapsular delivery.

The retention of the round pupil, preferably with a small single peripheral iridotomy, is desirable whenever the pupil will dilate sufficiently to allow the exit of the lens. No more prolapse or incarcerations are encountered with one than with the other when effective sclero-corneal suturing is employed. For the latter, direct radial appositional sutures are the best. He uses a sharp-cutting-edged atraumatic needle with 6-zero black braided-silk suture.

Applicable to both the extracapsular and intracapsular methods is the plan of raising the corneal flap by a central traction suture to permit a clear view of the iris and lens capsule and to avoid injury to the endothelium. This is a conservative procedure and does not lead to complications.

He has developed some new principles. First, the initial point or curvilinear pressure is entirely within the limbus of the

cornea because of the anatomic fact that the lens equator lies entirely within the limbus. Pressure here reaches the zonule whereas pressure over the sclera does not, and only traumatizes other structures. The initial pressure effort accomplishes preliminary rupture of the zonule below when the zonule is fragile or demonstrates the size, bulk, and consistency of the lens and the condition of the vitreous. It is understood that prior to the employment of any pressure, the surgeon will recognize conditions such as gaping of the incision, continued prolapse of the iris, creasing of the flap from puncture to counterpuncture, and other signs which may contraindicate any pressure.

After the initial pressure, the flap is elevated by the assistant while with point pressure the surgeon tilts the lens. Application of the forceps is made above. Then the assistant releases the traction suture.

The point pressure below at the 6-o'clock position with traction above at 12, then a shift to pressure at 8-o'clock and traction at 2 and a third shift to 10 and traction at 4-o'clock will loosen and permit delivery of a cataract that has a fragile zonule; or it will demonstrate that more traction, pressure, and rotation are necessary, and that the case belongs to the great class 2, with average resistant zonule or possibly to another small class 3 with greater-than-average resistant zonule. The application of moderately more pressure, traction, and rotation will result in delivery in class-2 cases, while in class 3—with resistant zonule and resistant capsule—the surgeon should be deterred from continuing or putting on more pressure, traction, and rotation.

It was in the handling of the latter

class that he first demonstrated from a clinical surgical standpoint the fact that the zonule is a lamella or membrane and not just a collection of fibers. He has shown that by direct interference, stripping or rubbing the zonule off safely from the equator of the lens is better than applying continued pressure and traction. The direct interference with the zonule is safe enough if used with proper surgical and anatomic knowledge and cool surgical observation and manipulation.

After successful intracapsular extraction with round pupil or with a coloboma, the use of eserine or equivalent miotic is indicated. The less instrumentation of the iris the better. With the use of eserine it is necessary only to make sure that the iris is not incarcerated in the edges of the incision. At the time of the first dressing, atropine may or may not be used according to indications.

*Discussion.* Dr. J. Goldsmith said that the technique described by Dr. Kirby conforms with our present knowledge of the gross and microscopic anatomy of the anterior segment of the eye. This knowledge is of tremendous importance, and permits the approach to the intracapsular-cataract extraction from an intelligent point of view. The Kirby technique of rupturing the anterior zonular bundles superiorly before extraction is important and is based on sound anatomic sense. The entire zonule, which arises from the surface of the orbiculus ciliaris, divides, at the junction of the anterior and posterior two thirds of the base of the ciliary process, into two membranes—the anterior and the posterior.

It is the anterior membrane of Hannover's canal superiorly which is ruptured by Dr. Kirby's technique.

The other technique described, with traction at the 2-o'clock position and at 10-o'clock, and the application of external pressure at opposite points below, also

gives maximum stretching to the zonular bundles and permits early rupture.

It is important to recall that the posterior zonular membrane is separate from the anterior border layer of the vitreous by virtue of the potential space of Petit. There are no zonular fibers in the hyaloid membrane.

He showed X rays of air in Petit's space and of metal in Hannover's canal.

Dr. John M. McLean said he felt it advisable to put in whatever type of suture is to be used before the eye is opened. To put a suture into solid tissue such as the cornea and sclera after the eye is opened adds to the risk of the operation. Pure conjunctival sutures are not sufficient. They do not prevent iris prolapse and, far from preventing, seem rather to encourage hemorrhage into the anterior chamber.

He asked if Dr. Kirby's zonular maneuver was feasible with a round pupil or if an iridectomy is necessary.

He said he always preached, and usually practiced, that if the capsule is ruptured or vitreous presents, the peripheral iridotomy should be converted into a complete iridectomy. When vitreous comes into the anterior chamber and a round pupil is left, in spite of miotics, a distorted pupil usually results and causes a prolonged postoperative reaction. When a round-pupil operation is done, miotics should be used postoperatively, but not when any cortex remains. That is why he suggested completing the iridectomy if the capsule is ruptured.

He asked Dr. Kirby in what types of cases he considered the extracapsular extraction better or at least as satisfactory as the intracapsular.

Dr. Daniel Kirby, in closing, congratulated Dr. Goldsmith on his research and said that it is important to realize the individuality of the vitreous and the zonular membrane. This can be demonstrated

when, in lifting the lens, a space of 2 or 3 mm. can be observed.

He said that he had never had occasion to regret appositional suturing after the section was made. In his opinion the McLean suture is the best of the preplaced sutures. In reply to Dr. McLean's questions he said it is quite feasible to strip the zonule from the lens when there is a round pupil. If the capsule ruptures, he does not necessarily complete the iridectomy, but he thought it indicated when there is a loss of vitreous.

Atropine should be used after the capsule is broken, otherwise eserine.

He said he thought the extracapsular extraction applicable in any mature lens, in heavily sclerosed lenses where the cortex is hard right up to the capsule, and in intumescent cataracts where the lens is greatly swollen. In these latter cases it is better to open the capsule and extrude the material, although it may be wise in some cases to let these cataracts mature and then choose between the extra- and intracapsular procedures.

#### A NEW PRINCIPLE OF EXOPHTHALMOMETRY

DR. ALFRED KESTENBAUM described his method of exophthalmometry as follows: A ruler two inches in width is held two inches from the eyes with its lower edge at the level of the anterior poles of the eyes. The patient looks upward, so that the lower limbus forms the anterior pole of the eyes and the sclera below stands vertical. The examiner looks over the ruler in such a way that the lower limbus of the patient's eye is aligned with the upper ruler edge. Then he looks at the other eye. If the position of the two eyes is equal, the limbus of the second eye is aligned with the ruler edge too. If however, the second eye is relatively enophthalmic, its lower limbus is below, so that a white scleral stripe is visible

below. The greater the relative enophthalmos, the wider the stripe.

A diagram giving the lateral view and projecting one eye over the other shows that the width of the ruler and its distance from the eye are the legs of a right isosceles triangle. The distance between the limbi of the two eyes (in projection) and the width of the scleral stripe are the legs of another small triangle, similar to the first; hence they are equal too. Thus the white scleral stripe, which can be measured immediately, gives the wanted relative enophthalmos. Since the triangle is many times as small as the first, errors of arrangement affect the result only slightly, for the range of error is only about 1 mm.

This "ruler test of exophthalmos" is based on a different principle than is Hertel's exophthalmometer because it employs the superior instead of the orbital margin, but they can be control tests for each other. The ruler test does not require special apparatus and can be quickly applied at the bedside.

*Discussion.* Dr. Percy Fridenberg said that Dr. Kestenbaum's method of exophthalmometry is one of triangulation and has many difficulties. The patient's head must be held steady, the measuring ruler must be exactly straight and the examiner must not move his head. An error of even one mm. of any of these factors would vitiate the result. He has found that the ophthalmometer makes a good exophthalmometer in a pinch. The patient's head is fixed and the mires are then focused exactly on one eye; if the mires have to be moved forward or backward when the other eye is focused, it is clear that there is a relative exophthalmos.

Dr. Dewey Katz asked about the discrepancies in the readings in cases of facial asymmetry with a different position of the eye in the orbits.



Dr. Kestenbaum, in closing, said that Dr. Fridenberg's method of measuring with the ophthalmometer was good but pointed out the disadvantage of not being able to use it at the bedside.

He said he had measured many normal people and found that some had a facial asymmetry and that this always took the form of the right eye being about 1 mm. in front of the left one. He had never seen the reverse in a normal person.

#### ACUTE EPIDEMIC KERATOCONJUNCTIVITIS

DR. MILTON L. BERLINER read a paper on this subject which was published in this Journal (January, 1943).

#### HERPES ZOSTER OPHTHALMICUS COMPLICATED BY EXTERNAL OCULAR PARESIS

DR. ALFRED WEINTRAUB reported the case of a 51-year-old white male who had excruciating headaches of the right side of the forehead and skull, a sty of the right upper lid, and a swollen preauricular gland. Two days later the patient developed a herpes zoster of the right side of the forehead and the sty disappeared. Three days following this, there was a paresis of the right external-rectus muscle followed by a paresis of the right superior-oblique muscle and then of the left superior-oblique muscle several days after that. Accommodation remained normal.

The patient was given salicylates and thiamine-hydrochloride injections of 50 mg. daily. Two weeks later the pareses were completely gone and the herpes eruption of the skin practically healed. The patient was able to resume work.

The literature shows a number of such cases of motor herpes. The oculomotor nerve is the most often involved, next the sixth, and then the fourth. Pathologically such cases are due to an encephalomyelitis or perhaps a polyneuritis caused by a virus or by its toxins, which might be

related to varicella. The patient gave no history of varicella among his immediate contacts. His serum was not tested for antibodies of varicella.

*Discussion.* Dr. Dewey Katz asked if Dr. Weintraub had any experience with diphtheria antitoxin in cases of herpes. He had used it and found that it did not prove any more satisfactory than other forms of treatment.

Dr. Daniel Rollett said that on two occasions he had advised diphtheria antitoxin for herpes and in both cases, according to the reports of their physicians, the patients experienced rapid relief from pain. Massive doses were used.

Dr. Weintraub, in closing, stated that he had not had any experience with diphtheria antitoxin in the treatment of herpes.

Sidney A. Fox,  
*Secretary.*

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#### WASHINGTON, D.C., OPHTHALMOLOGICAL SOCIETY

May 4, 1942

DR. E. LEONARD GOODMAN, *president*

#### ALLERGY AND IMMUNOLOGIC REACTIONS OF THE EYE

DR. EARL L. BURKY of the Wilmer Institute, in Baltimore, guest speaker of the evening, discussed this subject in an interesting and informative paper. He expressed the opinion that pollen injections are of some help and stated that the *Staphylococcus* is the usual organism found in the eye, and that it is possible to desensitize the eye to this organism. The consideration of sensitization to lens material is important in connection with cataract surgery, and desensitization may be done by repeated intradermal injections, according to Dr. Burky. He pointed out that, so far, there is nothing conclu-

sive regarding desensitization of individuals to uveal pigment in connection with sympathetic ophthalmia. Brucellosis, which in the eye produces a clinical picture similar to that of tuberculosis, is more common than most people realize, and a needle dipped in Brucellus broth and swept across the cornea will produce, after 48 hours, a low-grade iritis and a sensitivity to Brucellin although no damage would be done to the cornea. It is possible, he concluded, that the Brucellus-like organism may pass through a normal cornea and sensitize the eye, and that later an infection elsewhere in the body may reactivate the eye.

#### ANISEIKONIA

DR. ERNEST SHEPPARD presented a paper on this subject, pointing out the three types—physiologic, anatomic, and refractive. In the refractive type, the discrepancies may correspond to the refractive error, with the rule, or may not correspond, against the rule. If it is of lenticular origin, it may be symmetrical or asymmetrical. Symptoms include: obstinate asthenopia, inability to read for any length of time, inability to interpret what is read, photophobia, headache, gastric symptoms, and disturbed spacial relationships. It is important to be sure that we do not produce aniseikonia by using carelessly prescribed or poorly fitted lenses.

#### COATS'S DISEASE

LIEUTENANT ROY R. POWELL, (MC) U.S.N., presented a case report on this subject.

#### TUBERCULOUS CHORIORETINITIS

MAJOR AUSTIN LOWERY, JR., (MC) U.S.A., reported a case of this type.

#### FAMILIAL MACULAR DEGENERATION

DR. FRANK D. COSTENBADER gave a case report on this subject.

#### COLOBOMA OF THE CHOROID

DR. C. ROBERT NAPLES presented a case report of this type.

Sterling Bockoven,  
*Secretary-Treasurer.*

### CHICAGO OPHTHALMOLOGICAL SOCIETY

May 11, 1942

DR. SANFORD GIFFORD, *president*

#### CLINICAL MEETING

(Presented by the Eye Department,  
Cook County Hospital)

#### NODULAR CORNEAL DYSTROPHY

DR. RALPH SIEGEL presented J. Z., a man, aged 58 years, whose subjective symptoms consisted of intermittent pain in the left eye, accompanied by photophobia, of eight years' duration. In the lower half of the pupillary area of the left cornea, extending in a fan-shaped manner peripherally to about one half the distance to the limbus, were numerous gray nodular elevated opacities, the size of a pinhead and smaller. The corneal epithelium was intact; there was no impairment in corneal sensitivity. Corrected vision was 20/30. Biomicroscopic examination showed numerous corneal, sub-epithelial, gray, nonstaining nodular opacities, some of which extended deep into the stroma. Descemet's membrane was wrinkled.

Tuberculin test 1:100,000 was positive.

This is presented as a case of nodular corneal dystrophy resembling the Salzmann type, but without known previous phlyctenular keratitis.

#### EXPERIENCES OF FIFTY YEARS OF OPHTHALMOLOGY

DR. GEORGE F. FISKE presented a paper on this subject.

## OCULAR FINDINGS IN CHILDHOOD ENDOCRINOPATHIES

DR. CARL APPLE and (by invitation) DR. I. P. BRONSTEIN presented a paper on this subject which has been published in this Journal (January, 1943).

## CONCERNING RETINAL DETACHMENT

DR. HARRY S. GRADLE presented a paper on this subject.

Robert Von der Heydt.

COLLEGE OF PHYSICIANS OF  
PHILADELPHIA

## SECTION ON OPHTHALMOLOGY

October 15, 1942

DR. ALFRED COWAN, *chairman*

## POSTERIOR PHLYCTENULAR KERATITIS

DR. G. G. GIBSON presented the case of a white woman, aged 36 years, who complained of recurrent episodes of ocular inflammation since childhood, and who was found to have active and healed phlyctenules and phlyctenular pannus on the anterior surface of the cornea. While under treatment she developed a slowly progressive lesion on the posterior surface of the cornea, which eventually extended well into the pupillary area and seemed destined to involve the entire cornea. It was characterized by a dense yellowish crystalline deposit which was vascularized. The adjacent cornea was normal. This was interpreted as an allergic posterior phlyctenule which spread by its own presence in contact with normal cornea.

Five delimiting keratotomies were performed in an effort to prevent further extension. They were rather successful in stopping the main lesion, although the cornea became somewhat infiltrated be-

yond the surgical scar. The degree and frequency of the ocular inflammation was materially benefited by an extensive course of old tuberculin extending over a three-year period.

*Discussion.* Dr. G. P. Meyer stated that it was rather difficult to discuss a subject one had never heard of before. A phlyctenule ordinarily is looked upon as a cellular response to an allergic hypersensitivity in a certain site. In phlyctenular keratitis the allergic or sensitized site is in the cornea, and with the introduction into that site of the reacting agent, a cellular response appears and that response, as a matter of fact, is a small pustule.

To this degree, one could not question the diagnosis of the essayist, because the initial episode in this condition was a true phlyctenule. But the second episode, where the major response was a crystalline deposit, left one a little confused.

Crystalline changes in the eye are, of course, not new. They occur in the cornea as degenerative changes with accompanying scar tissue. They have been found in the anterior chamber in amounts that simulate a hypopyon and are found in rare occasions on the iris. These are usually degenerative and not inflammatory nor allergic.

It would be rather hard to explain why the response in the cornea in this particular case was crystalline in character. It might be that there was some local disturbance in the oxidative processes in the cells; there might have been some degenerative process initiated by the adjacent inflammatory process. But, it struck him that one might here suggest the possibility of the diagnosis of a dual lesion, in which one had a real, initial, classical phlyctenular keratitis followed by some disturbance marked by crystalline deposits as a secondary manifestation.

Regarding the treatment: Delimiting

keratotomy used to confuse him because it was hard for him to understand the value of cutting off the blood supply to a lesion that one hoped to heal. But he had learned that the purpose of that operative procedure was to cut off not the ingress of immunologic or healing agents, but rather to restrict exciting agents from an approach to the wound. Delimiting keratotomy, too, confused him because he could not understand why there should be any therapeutic value to the delimiting keratotomy other than the induction of hypotony and the reintroduction into the eye of new fluids with a higher immune-body content. But he had since read that this procedure has an additional value in the epithelization of the wound that is made, because the epithelial ingrowth in the superficial layers of the cornea act as a barrier.

The most interesting therapeutic agent here was the tuberculin. Clinically, it is well known that because of the etiologic relationship of tuberculosis to this condition, tuberculin desensitization is a valuable procedure.

One point that might help in establishing whether this second crystalline condition was truly a manifestation of tuberculin hypersensitivity or the phlyctenular state, is to observe the effect of the tuberculin on the lesion. Dr. Gibson stated in his paper that when the tuberculin therapy was stopped, symptoms recurred. He wished Dr. Gibson would tell them whether there was any corneal response to the cessation of this treatment; whether the deep lesion improved and grew worse with the giving and not giving of the tuberculin.

He thought that would be a valuable help in establishing the diagnosis of the tuberculous nature of the deep lesion. But when Dr. Gibson said that the lesion grew worse, he just wondered what the character of that response was, because if there was an exacerbation in the activ-

ity of the deep lesion, he would take it to mean that this crystalline deposit was truly a phlyctenular manifestation.

Dr. H. M. Langdon said that if he understood Dr. Meyer correctly, he took him to be a little doubtful as to the justification of the diagnosis of posterior phlyctenular keratitis. It seemed to him that Dr. Meyer's doubt was justified. To him, a phlyctenule was a definite entity, and had a definite location. It seemed to him a somewhat better diagnosis would have been: an interstitial keratitis of tubercular origin.

Dr. W. Zentmayer observed that some years ago Dr. Byers of Montreal discussed a lesion somewhat similar to the one that Dr. Gibson had described. This was in conjunction with a superficial phlyctenule and resembled somewhat the condition as shown by Dr. Gibson. Observation with the slitlamp disclosed a white opacity in the deeper layers of the cornea anterior to Descemet's membrane. But, it was concurrent with the primary phlyctenule on the cornea.

Dr. A. Cowan remarked that in his opinion Dr. Gibson was justified in diagnosing this condition as phlyctenular keratitis. Phlyctenular keratitis very frequently starts deep. As a matter of fact, it always starts in the substantia propria, even though it occurs first in the bulbar conjunctiva. The epithelium is always affected later and the ulcer is formed when there is necrosis of the overlying epithelium. The first appearance of phlyctenular keratitis is in the anterior portion of the substantia propria beneath Bowman's membrane.

Often, in cases of phlyctenular keratitis, if one looks with the corneal microscope and slitlamp, deep infiltration is seen. In most cases when it starts deeply, even deep vascularization is apparent: vessels coming from the ciliary system; they do not always come over superficially.

If a healed ulcer after phlyctenular keratitis is carefully examined with a narrow beam of the slitlamp, one sees that the scar is always considerably below the level of the new-formed epithelium. Healing of the epithelium probably takes place before the lesion itself is healed; very often they have a perfectly regular and smooth anterior surface, although it looks very much, on ordinary examination, like a depressed scar.

Dr. G. G. Gibson wished to thank collectively the discussers for their enthusiastic participation. It proved his original statement that this case illustrated some controversial points in corneal disease.

First of all, Dr. Meyer had brought up some questions which were difficult to answer and which were very much to the point in this condition, and he was quite in agreement with Dr. Meyer's explanation of this case. This represented an allergic manifestation of tuberculous disease.

Those who would demand the isolation of organisms or positive histologic evidence of tuberculosis from this lesion, would be disappointed, and there would be no evidence of tuberculosis as such. The diagnosis had to be made on clinical bases. They were unfortunate, in that they had no positive X-ray studies nor sputums, and for that reason, they had to be content with less conclusive types of diagnosis. Nevertheless, a diagnosis was necessary, and his point about the allergic nature of this condition was, he believed, unquestionably true. Why it should be fundamentally a crystalline lesion was difficult to answer, but he thought it to be due to the fact that here there was a low-grade allergic inflammatory process deep in the cornea which differed from the superficial variety of phlyctenular keratitis in that there was no drainage mechanism. The superficial variety of phlyctenular keratitis could ulcerate and drain, but this lesion deep in

the substantia propria could not drain and the nature of this lesion differed from ordinary corneal disease in that it extended, not because of the extension of infection, but because of the presence of this lesion—it extended because of its own presence in the cornea.

In other words, the lesion made pressure on the adjacent normal cornea and that became involved, so that the metabolism of that part of the cornea was interfered with, producing a fatty degeneration and crystalline deposit in the cornea. As they watched this lesion with a slitlamp that mechanism could be determined to be at work. The very margin of this lesion was absolutely free from edema and free from infiltration. There was no evidence of keratitis other than the phlyctenular type.

Dr. Meyer also asked why keratotomy worked. That was difficult to say, but it probably worked because scar tissue was formed in the incision and when the lesion came in contact with the film of scar tissue, it no longer came in apposition with the normal cornea. Then it could not cause the changes of pressure against the normal cornea, which brought that change and allowed the lesion to extend.

In answer to Dr. Meyer's question about the effect of old tuberculin, he must confess that they did not have the evidence that he demanded, in that there was no improvement in the lesion, as far as the lesion *per se* was concerned, with the use of old tuberculin. The appearance did not change when the patient stated that the eye felt better or when it felt worse, but there was a change in the vascular reaction. The ciliary injection and the like were diminished and photophobia and things of that nature were diminished at the time the patient stated that the eye felt better; but the appearance of the lesion did not change.

He thought that fitted in with the fact

that the purpose of the old tuberculin was not to modify the course of the lesion but to produce a desensitization of the allergic state to the tubercular protein, and, in view of that, he thought it was consistent with the nature of the lesion and explained why there was no change in the appearance of the lesion when it did improve subjectively.

Dr. Langdon's objection really did not apply in this case, because it was not a case of tuberculous keratitis. It had none of the infiltration and edema nor any of the features which go along with an interstitial keratitis. It was because of the fact that all the aspects of this case were so different from the condition that Dr. Langdon mentioned that he considered it worthy of reporting, and keratotomy could be contraindicated in tuberculous interstitial keratitis.

#### THE ETIOLOGIC ROLE OF FOCAL INFECTION IN DISEASES OF THE EYE

DR. M. SOLIS-COHEN stated that the etiologic role of focal infection in diseases of the eye has been recognized for at least 300 years, having been referred to by Riverius, Fernelius, and Steno, writing in the seventeenth century. Among the many distinguished ophthalmologists who had stressed the relationship between focal infection and certain diseases of the eye were Brunton, Bryan, deSchweinitz, Mackenty, Lang, MacKenzie, McConachie, Knapp, Posey, Risley, and Shumway.

The presence of tuberculosis and syphilis does not rule out focal infection as the cause of an eye condition. Among the affections of the eye of which focal infection has been demonstrated to be one of the etiologic factors are: conjunctivitis, scleritis, episcleritis, uveitis, chorioiditis, keratitis, iritis, retinitis, optic neuritis, retrobulbar neuritis, amblyopia, amaurosis, ptosis, strabismus, and paraly-

sis of the muscles of accommodation. Ocular symptoms of bacterial toxemia from focal infection are: burning of the eyes, blurring of vision, scotomata, asthenopia, eye fatigue (especially after a slight amount of near work), impairment of accommodation, and weakness of convergence.

Focal infection may exert a baneful influence upon eyes that have been operated on, keeping up the inflammation and being responsible for secondary infection. The conception of foci of infection should stress infecting organisms rather than infected tissue. When bodily resistance is weakened by fatigue, trauma, and other factors, the infecting bacteria in the primary focus metastasize and produce a focal infection. The trauma of an operation upon a focus of infection, by lowering bodily resistance, might spread the infection to the heart, kidneys, joints, and eyes. These dangers might be minimized by exercising gentleness, avoiding multiple tooth extraction, and raising resistance by preoperative and postoperative care, preoperative autogenous vaccinothrapy, and the administration of sulfonamides preoperatively and postoperatively.

To influence the focal infection favorably, the operation must be performed on the etiologic and primary focus; secondary foci should not be neglected; and all infected tissue should be removed. The surgeon's knife, however, does not remove the infecting microbes, which remain until overcome by the patient's defensive forces. The latter might occur spontaneously, but frequently require artificial stimulation of antibody production by the administration of a potent autogenous vaccine, preferably a pathogen-selective vaccine.

*Discussion.* Dr. H. M. Langdon remarked that he thought Dr. Solis-Cohen's paper was all-embracing. But, he feared

it was read before the wrong Section. The difficulty that he had was in getting the laryngologists to take active steps in cases where there was a very probable focus of infection, especially in the sinuses; unless they found some very acute, flagrant condition.

In his own personal experience, it had been a low-grade hyperplasia of the lining membrane of the sinus which had produced the ocular conditions. He did not remember ever having seen an ocular infection from a very acute flagrant outburst of sinus infection. The cases he had which baffled him were the ones in which the laryngologist was very apt to say: "There is no sinusitis at all," and yet one had excluded everything else: dental X rays, general examination, everything.

One case in particular was a woman who had a uveitis. Dr. Ross Skillern saw her, operated on the sphenoid on that side, and the eye cleared up very promptly. Dr. Skillern died, and within two years after his death the other eye of the same patient became similarly involved. She went to another very excellent rhinologist, who had assured him that there was nothing in the sinuses that could possibly cause it. Her vision deteriorated to 5/60, and he asked the rhinologist if he would please do something because he knew it was the sinus condition. The rhinologist did operate on a low-grade sphenoiditis which he had been treating and immediately the eye began to clear up. The woman had 5/4 vision on the side which was promptly operated on, but on the other side she never got below 5/10 because the damage was done. Had the rhinologist acted a little more promptly, he was sure they would have secured as good a result. That had been his experience a great many times. The rhinologist seemed to be loathe to take very active steps in dealing with these cases unless there was some fla-

grant, outspoken set of symptoms to guide him.

From his experience, the dentists were very quick to coöperate. They would be guided by their X rays and would act accordingly. He would like to ask Dr. Solis-Cohen one thing: Did he find, in the material into which he had delved, any reference among the dental cases to what they now call an apical abscess of the teeth? Or was it simply referred to as a tooth infection or mouth infection? He had often wondered just exactly how far back that was recognized as a definite entity.

Dr. M. Solis-Cohen was sure that Dr. Langdon naturally knew all about focal infection, having been an assistant of deSchweinitz, but that he probably failed to realize that most of the recent books on ophthalmology ignore focal infection.

The older writers did not speak of apical abscesses. The teeth which they pulled out 100 years ago were, as a rule, badly infected teeth. It might be that in some cases they regarded teeth with apical abscesses as normal. Before the advent of the theory of focal infection, the action of the diseased tooth was thought to be a reflex one. The ophthalmologist diagnosed an iritis, pulled the tooth out, and the patient got well. It might be that some cases which he had cited as instances of focal infection were really reflex in nature.

He had had a quarrel with the laryngologists for 25 years. He had read papers before the Otolaryngological Section of this College and before the Philadelphia Laryngological Society, and still felt that the laryngologists did not understand the nature of focal infection nor of foci of infection. The laryngologist says, when he has taken out a pair of tonsils, that he has removed the focus of infection, and tells the referring physician that there is no longer any focal infection.



If a patient came with the tonsils out, he would look into the throat and say that there was no focus of infection present. Yet the same infecting organism that had been originally present in the tonsils was now in the tonsillar fossae, or on the tonsillar pillars and adjacent tissues, and in the nasopharynx, where it continued to infect the patient. In other words, the focus of infection remained. There was no diseased tissue present, however, without which the otolaryngologist would not recognize an infection.

Skilern 19 years ago in discussing Dr. Solis-Cohen's paper on "The rhinopharynx as a site of focal infection," said that unless he could see diseased tissue in the rhinopharynx he would not believe that infection existed there.

The otolaryngologists had the same attitude toward sinusitis. Unless they saw pus coming out of a sinus they would say that the sinus was normal, which often was not the case. After they had opened and drained the sinus they said the focus of infection had been removed, and yet the infecting organisms were still in the sinus and in the nares. Draining a sinus did not make these bacteria vanish. One could not force an otorhinologist to open a sinus that looked all right to him. So, when convinced that the sinus was a focus of infection, Dr. Solis-Cohen made a vaccine to increase the patient's resistance—his antibody production—so that the newly formed antibodies in his blood, whose production was thus stimulated, would cure the infection the otorhinolaryngologist would not treat.

#### A CLASSIFICATION FOR CONGENITAL PTOSIS

DR. E. B. SPAETH reported a series of cases of congenital ptosis which were analyzed and classified upon the basis of unilaterality and bilaterality: upon the presence of an accompanying paralysis of

the superior recti, unilateral, homolateral, and contralateral, or bilateral; upon the presence of the other third-, fourth-, or sixth-nerve paralyses; considering other congenital defects of the lids and the palpebral fissures; and as seen with the jaw-winking reflex and with a retraction syndrome. As a result of this analysis, eight general classes appeared as follows: Class 1, unilateral ptosis without any other defects, 40 percent of all cases. Class 2, unilateral ptosis with involvement of the homolateral superior rectus, 21 percent of all cases. Class 3, bilateral ptosis without superior-rectus involvement, 7 percent of all cases. Class 4, bilateral ptosis with superior-rectus involvement, 8 percent of all cases. Class 5, unilateral ptosis with involvement of both superior recti, frequently more marked in the homolateral eye, 1 percent of all cases. Class 6, ptosis with more or less complete third-, and even fourth- and sixth-nerve paralyses, 9 percent of all cases. Class 7, ptosis with classical jaw-winking reflex, 2 percent of all cases. Class 8, ptosis with the Duane's retraction syndrome, 2 percent plus of all cases.

The remaining 10 percent of cases are those which include conditions such as neurofibromatosis, ptosis with congenital colobomata, ptosis with squint as one sees in feeble-minded children, and the ptosis of the congenital conjunctival defects.

Surgery for these conditions was then considered upon the anatomic findings present in any one group to emphasize the absolute truth of the statement made that only one operation would fit one type of case, or one group of anatomic conditions present. Varied surgery was a definite necessity for the proper correction of these conditions. The other extraocular defects present in any one case must be corrected before the drooping lid itself can be operated upon. Early diagnosis and adequate surgical care, depend-



ing upon the surgical therapy indicated, was needed, and the operator must not fit any one operation which he most prefers to do in these conditions, to all cases.

*Discussion.* Dr. W. I. Lillie said that he enjoyed Dr. Spaeth's presentation very much. Dr. Spaeth had brought out very well that even with large classification of ptosis there are three general types of surgical procedure that one has available for correcting congenital ptosis.

The interesting clinical side of ptosis is to try to correlate, at as early an age as possible, the probable cause of the ptosis. It might be due to an organic central lesion: intramedullary mid-brain, extramedullary, or orbital. If not, as the child grew, the ptosis might improve. He agreed with Dr. Spaeth that one should not hastily institute a surgical procedure in too young an individual.

If organic lesions were eliminated in the differential diagnosis, the choice of surgery depended upon the clinical findings. If there was no action of the levator, utilization of that muscle in the expectation of getting lid action would be futile. The superior rectus is also usually affected, either partially or completely, and those operations directed toward the use of the levator or the superior rectus produce end results that are not always gratifying to the patient, the parents, or to the surgeon. They frequently have to resort to using a muscle, the fronto-occipital, which was not ordained to have any direct function as to lifting the lid. As a matter of fact, the normal action of the lid is not a lift. The action of the levator pulls the upper lid back over the eyeball, so a normally placed eyeball is also nec-

essary for proper function.

Fortunately, from the clinical standpoint, the use of the fronto-occipital muscle usually produces a cosmetic improvement. The numerous types of surgical procedures describing the utilization of the frontalis muscle reveals in itself that something is wanting in any one or even in combinations of procedures from a surgical and cosmetic standpoint; but in the severe cases, even though a perfect function of the lid is not obtained, the improvement is sufficient to warrant surgical interference. He thought that the patient and the relatives should be told without hesitation that a perfectly normal lid action was not to be expected. So, all in all, the surgical treatment of congenital ptosis still leaves much to be desired in changing the altered physiology and bettering the cosmetic result.

Dr. E. B. Spaeth thanked Dr. Lillie for his discussion. There was just one more word he wanted to say: The importance of this whole discussion was that in 35 percent of ptosis cases there are complications; that is, they have factors of importance which are beyond the simple drooping lid and the epicanthus. Those are the instances Dr. Lillie had referred to, which needed the varied surgical procedures to be properly handled.

A cosmetic result that one knows is a wretched physiologic operation might satisfy the patient's parents. On the other hand, he had been pleased with results which he thought were good physiologic successes, and had had the patient's parents say: "Well, the eyelid is not much better, is it?"

Warren S. Reese,  
*Secretary.*

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## THE OPHTHALMIC INTERNE PROBLEM AND THE AMERICAN BOARD OF OPHTHALMOLOGY

The decision reached by the Procurement and Assignment Service in collaboration with the Surgeons General of the Army, Navy, and Public Health Services relating to the appointment of hospital internes, assistant residents, and residents presents an immediate problem both to ophthalmic hospitals and to the American Board of Ophthalmology. Beginning January 1, 1944, the total number of internes that may be appointed on any service is limited to three fourths the number on duty in 1940. The total number of assistant residents and residents is limited to two thirds of the 1940 quota. The term

of appointment for the internes, assistant residents, and residents is limited to nine months. On the completion of the nine months' service as internes, one third of the internes may be reappointed as junior assistant residents, and at the completion of this nine months' service, one half of the junior assistant residents may be reappointed either as senior assistant residents or as residents. All physically qualified men not reappointed as junior or senior assistant residents become immediately available for military service. The only exceptions to this arrangement are women and physically disqualified men, but these may not be appointed or reappointed in excess of the basic quota. No male physician may be appointed on the resident hospital staff unless he either

holds a commission in the armed services, has applied for a commission, or has been rejected. This ruling applies to all hospitals and all services including such specialized institutions as ophthalmic hospitals and the ophthalmologic services of general hospitals.

The present requirements of the American Board of Ophthalmology for examination and certification are a year of general internship, or its equivalent, as a prerequisite to the study of ophthalmology, and three calendar years of training in the specialty. Ophthalmic hospitals, with the few exceptions which can provide the equivalent of a year of general internship, derive their internes from the pool of physicians who have completed a year of general internship. Flexible and lenient as the Board has been in interpreting the present requirements, and sympathetic as has been its attitude in the recognition of the difficulties which now confront the prospective ophthalmologist in obtaining an adequate training, nevertheless a year of preliminary internship and three calendar years of training are the published requirements for examination and certification.

As a result, the new graduate in medicine who wishes to enter ophthalmology finds himself confronted by an insoluble dilemma. If he complies with the published requirements of the Board and takes one year, or nine months of general internship, on its completion he is ineligible for appointment as interne in an ophthalmic service—he must either enter military service or be reappointed as one of the quota of assistant residents. If, immediately after graduation, he takes an internship in an ophthalmic hospital, he automatically disqualifies himself for later examination and certification by the Board for the reason that he has not fulfilled their requirement for the preliminary internship of one year.

The net result of this is that since the pool of men who have completed a year of general internship is now completely dried up, and since the requirements of the Board seemingly prevent men from entering the study of ophthalmology directly on graduation from medical school, the ophthalmic hospitals find themselves without sufficient applicants to fill their residents staffs. With a depleted senior visiting staff and a greatly increased clinical load, the great majority of ophthalmic hospitals are now suddenly bereft of internes and will soon be without assistant residents and residents.

The solution of this problem is not easy. Even though it may result in a temporary and regrettable lowering of standards, some action of the American Board of Ophthalmology reducing its present requirements appears necessary. Such a reduction in requirements might be waiving the required preliminary year of general internship and reducing the required three calendar years of training to three periods of nine months each for the duration of the National Emergency. If this were done, medical graduates might enter directly into the study of ophthalmology with the assurance that at least one third might receive 18 months' training, and one sixth, 27 months' training. This assurance, together with the emphasis laid on ophthalmology by the Medical Corps of the Air Service, might be enough to attract a number of men into ophthalmology sufficient to supply the minimum needs of the ophthalmic hospital, and to prevent a shutting-off of the flow of physicians in the specialty.

Alan C. Woods.

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#### ANISEIKONIA DOUBTS

Most ophthalmologists who have any practical familiarity with the subject are by this time satisfied as to the validity

of the basic principles of aniseikonia, and are frank to recognize the existence of clinical cases in which symptoms of long standing, hitherto unrelieved by the usual refractive methods, have disappeared after the patient was fitted with size lenses.

What most of us do not yet know and many of us would like to know is, how large a proportion of the difficulties apparently relieved by aniseikonic measurements and prescription were capable of relief in no other way and what proportion could have been relieved by more complete accuracy in refractive measurements without the aid of size lenses.

The present writer hastens to acknowledge that he has personal familiarity with cases in which he feels no doubt whatever as to the necessity of the aniseikonic measurement or as to its being definitely responsible for the success finally achieved. In the hands of a skilled and conscientious worker, some refractive measurements can be established with a precision that is beyond doubt or criticism. When such correction, supplemented by size lenses, clearly accomplishes something that the refractive prescription alone could not accomplish, the proof seems final.

But for testimony to be reliable we must have agreement between experts as to the principles and practice involved. Such agreement is lacking in refraction work. In reading the literature on aniseikonia it is often difficult to avoid the feeling that the testimony as to the previous refraction work, and therefore the testimony as to the necessity for aniseikonic measurement and its share in good results, is incomplete. This uncertainty may exist with regard to reports by refractionists for whose work we have a good deal of respect.

There may be workers in aniseikonia who are disposed to urge that if a refractive correction has failed, and success in

relieving the patient is then attained by combination of the same prescription with size lenses, no further proof as to the necessity and value of the aniseikonic addition is required. But this is a very flimsy argument. It is about as satisfactory as to say that, because a patient whose refractive correction in clear glass was inadequate became more comfortable upon the addition of a protective tint, the treatment that he most needed was a reduction in the intensity of light. Yet many of us know that by improving the refractive correction such a patient might have been made entirely comfortable without the use of tinted lenses.

Patients with uncorrected hyperopia or astigmatism, or with improperly balanced corrections, do in fact frequently lose all their dread of bright light after receiving the proper refractive measurement. Again, we have all seen patients who had previously worn a vertical prismatic addition to an incorrect refractive prescription but showed no need for the prism after the refractive correction was properly regulated.

In somewhat analogous fashion, there are surely some aniseikonic patients who could be made comfortable by proper refractive measurement and without size lenses, but who, receiving an aniseikonic addition, are rendered more or less comfortable in spite of imperfect refraction; and, on the other hand, there are probably a number of wearers of size lenses whose improvement in comfort is actually due to an improved refractive measurement and not to the aniseikonic lenses.

Without making an attempt to survey the whole literature of the subject, the present writer has looked through three recent articles on aniseikonia. All of these articles are ably and judiciously written. But they vary considerably as to their method of presenting and assessing the scientific evidence.

All three authors have for a number of years been associated with institutions where aniseikonic apparatus was in use and a careful record was made of results. One article is chiefly concerned with the replies received from patients as to the extent to which their aniseikonic corrections proved helpful. The general conclusion of this article is emphatically that aniseikonic corrections are brilliantly successful in a number of patients.

The second author gives elaborate details as to the refractive, muscular, and aniseikonic findings in every case; records in each instance that the patient had worn many previous refractive corrections without relief of his symptoms; but says nothing at all as to the formulas of the glasses previously worn or the extent to which they differed from those prescribed with the size lenses.

The third writer, very well known for his clever work in the field of aniseikonia, favors us in every case with the formula of the refractive correction previously worn. His examples include several cases in which the relief afforded by aniseikonic correction appears to have been striking or even dramatic.

The article last mentioned also makes rather elaborate allowance for searchings of the scientific conscience, by citing one case in which a significant refractive change was successfully prescribed without any provision for a duly recorded well-marked aniseikonic difference; and another case in which a marked hyperphoria was adjusted with prisms in preference to correcting a rather large size difference which, we are told, disappeared upon wearing the vertical prisms.

Yet to some of us it may be rather distressing to find that the same article belittles the significance of certain refractive details to which we are disposed to attach a good deal of importance. For example, an assistant chemist aged 26

years, referred by another prominent ophthalmologist, and who had persistently complained of headache, had been wearing, in addition to an important cylindrical element in the left eye,  $-0.62$  sphere for the right and  $-0.75$  sphere for the left eye. "Our refraction" is given by the author as including, with approximately the same cylindrical lens in the left eye, the following spheres: R.E.,  $-0.62$ ; L.E.,  $-0.37$ . "Since" says the author, "our refractive findings were essentially the same as the correction the patient had been wearing, we prescribed the correction for the aniseikonia."

This patient's headaches were completely eliminated. But it will be noted that a difference of  $0.37$  sphere had been made in the refractive correction of the left eye. How many of us will be willing to admit that such a difference in the spherical balance between the two eyes might not easily have produced all the headaches of which the patient had complained, without any reference to his slight meridional aniseikonia; and why was it thought scientifically profitable to include the low aniseikonic correction without first trying the effect of the improved refractive measurement?

The very next case recorded in the same article finds a like difference of  $0.37D$ . in the spherical balance of the two eyes of a 36-year-old professor of physics, the cylindrical element of the previous formula being unchanged except slightly as to axis. It may be remarked that the patient had previously worn a reading correction which did not harmonize with his distance glasses; but the essential criticism of the case report is that here again the evidence fails to satisfy us as to whether the cure was due to the size lenses or chiefly or wholly to the modified refractive formula.

In the issue of the American Journal of Ophthalmology for August, 1942, the

present writer discussed a Dartmouth College publication entitled "Motivation and visual factors." The studies summarized in that volume included a good deal of work on refraction and aniseikonia. The points of view there represented as to the relative importance of certain refractive errors may not improperly be given some significance, since the Dartmouth Eye Institute, an offshoot of the College, is the fountainhead of the teaching and practice of aniseikonia.

In the editorial comment on "Motivation and visual factors," attention was called to the following examples of what some refractionists will regard as loose thinking:

(1) A student with alternating convergent strabismus had a greater hyperopia in the right than in the dominant left eye, but was ordered a higher correction for the left eye "in order to blur the left dominant eye," and at the same time a "size difference" of 0.75 percent was added. The student who had been given this weird combination found himself inconvenienced, and was later relieved by a new prescription from his own ophthalmologist.

(2) A student whose total error called for +0.62 sphere in the right and +0.37 sphere in the left eye, with a small astigmatic error, was dismissed as needing no visual correction. The same occurred to a student who accepted R. E. +1.25 sphere -0.37 cylinder axis 10 degrees, L. E. +1.25 sphere -0.37 cylinder axis 180 degrees, and whose symptoms were chiefly psychologic.

(3) In another student, 1.50D. was regarded as a small amount of myopic astigmatism, and a previous correction with 0.50D. cylinder was spoken of as a "slight undercorrection."

Many ophthalmologists will interpret such opinions concerning the importance of refractive errors as affording a very

poor foundation for the creation of a body of scientific evidence regarding the necessity for and the value of size lenses.

Taken in the mass, the testimony in support of the importance of aniseikonia is impressive. Unfortunately, several factors make it difficult for the average ophthalmologist to satisfy himself as to the weight to be attached to the subject. One such factor is that the very expensive necessary equipment is entirely in the hands of a few specially trained individuals, not many of whom are ophthalmologists.

Time and other circumstances do not permit the average ophthalmologist to supplement his refractive findings with aniseikonic tests, or to compare the results obtained by patients before and after the incorporation of size lenses in the prescription.

As Lawrence T. Post points out (Southern Medical Journal, 1942, volume 35, July, page 649), not only is it impossible for the test to be made by the average ophthalmologist, but "it is not possible as conditions now exist to have the test made on all patients upon whom one would desire to have it made." Post further observes that the examination is so time-consuming and meticulous that it would not be likely to interest many ophthalmologists. "We have found it impossible," he says, "to make more than two or three, or at the most four tests in one day with one technician and one instrument." Incidentally, it may be remarked that these facts presumably explain why the Dartmouth Eye Institute has been instrumental in training and appointing optometrists, rather than ophthalmologists, for the handling of aniseikonic equipment at various special centers.

Most ophthalmologists will have to depend upon the statements and work of others in this field. Thus it is particularly desirable that, for some time to come, investigations at aniseikonic centers be con-

ducted in accordance with the methods of strict scientific research. But, to say nothing of the additional expense involved, not many patients of the more intelligent and responsible type would consent to make lengthy trial first of the refractive correction without size lenses and afterward of the same correction in combination with size lenses; although this is presumably the only way to approach completely satisfactory demonstration.

No such exact method has ever been pursued in regard to refraction, in order to compare various techniques of examination and prescription. It is doubtful whether such a method can be completely followed with regard to any group of patients unless they happen to be students attending a collegiate institution and are kept under close observation. It would be helpful if, in considering such records as have been made available by the Dartmouth Eye Institute and similar centers, doubts of the kind suggested in this editorial could be avoided.

W. H. Crisp.

## BOOK NOTICES

### BIOMICROSCOPY OF THE EYE.

Volume I. By M. L. Berliner. Cloth-bound, 709 pages, 512 illustrations, 40 colored plates. New York, Paul B. Hoeber, Inc., 1943. Price \$17.50.

The writer does not have the habit of being extravagant in his praise of many books sent to him for review. But, to be less than warmly enthusiastic over this beautiful contribution to the literature of the slitlamp would be doing an injustice to author and publisher alike.

American readers of German have had the advantage of the German edition of Vogt on this subject, with its many fine colored illustrations and interesting case reports, but this book is the first slitlamp

text in English, known to the author, which contains colored illustrations. There are 40 pages of beautiful colored plates covering the lesions of the conjunctiva, lids, cornea, sclera, and anterior chamber.

The second volume is to be devoted to the iris, vitreous, and lens, and a description of special methods of illumination.

The text is written in textbook style, from the point of view of individual cases seen by the author. It therefore serves better as a teaching medium than would a book confined to rare cases. The final chapter is on "Gonioscopy," for the understanding of which it is very helpful. The extensive bibliography and index conclude the book, which is certain to be utilized by all who are interested in the slitlamp, and this surely includes the majority of ophthalmologists.

Lawrence T. Post.

ASTIGMATISMO, BI-ASTIGMATISMO Y COMBINACIONES BICILINDRICAS (Astigmatism, biastigmatism, and bicylindric combinations); with tables for conversion of bicylindric combinations into spherocylinders. By Manuel Márquez, Professor of Ophthalmology of the Faculty of Medicine of Madrid, etc. Paper covers, 126 pages, 30 illustrations. Published by the author, Mexico, 1943. Price not stated.

This excellently written brochure restates the author's often propounded views as to so-called biastigmatism (the existence of lenticular as well as corneal astigmatism). The subject was discussed by Márquez himself in this Journal, 1942, volume 25, page 1458. See also criticisms and correspondence in this Journal, 1930, volume 13, page 906; 1931, volume 14, page 160; and 1931, volume 14, page 164.

The author's technique of examination for refractive errors, based upon initial use of the ophthalmometer, is set forth in detail. It may be noted that the author has a frank contempt for the cross-cylinder tests. The tables for conversion of bicylindric combinations into spherocylinders occupy 32 pages.

W. H. Crisp.

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## OBITUARY

LESLIE JOHNSTON PATON  
(1872-1943)

(Extracted from British Journal of  
Ophthalmology, July, 1943)

Mr. Paton died on May 15, 1943, after a long illness. He had played an important part in the British Journal of Ophthalmology and especially its financial affairs, having been connected with that journal since early in 1917, shortly after its foundation.

Paton was born in Edinburgh in 1872, studied at Glasgow and Cambridge, and

took his medical training at Glasgow. He worked with Marcus Gunn for many years, both at Moorfields and at the National Hospital, Queens Square, where he developed a reputation in the field of ophthalmic neurology. He became president of the Ophthalmological Society of the United Kingdom in 1929, and president of the Section of Neurology of the Royal Society of Medicine in 1930. He served as treasurer of the English-Speaking Ophthalmological Congress held in London in 1925, and also as chairman of the Council of British Ophthalmologists and treasurer of the International Ophthalmological Council. He did not write much, but made a number of original observations which were publicized by more prolific writers. Of imposing personal aspect, he carried his Scots accent throughout life. In his presidential address before the Ophthalmological Congress he remarked that, though born and bred in Scotland, he had lived long enough in London to make himself understood by southerners.



# ABSTRACT DEPARTMENT

EDITED BY DR. WILLIAM H. CRISP

Abstracts are classified under the divisions listed below, which broadly correspond to those formerly used in the Ophthalmic Year Book. It must be remembered that any given paper may belong to several divisions of ophthalmology, although here it is mentioned only in one. Not all of the headings will necessarily be found in any one issue of the Journal.

## CLASSIFICATION

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|--|--|
| 1. General methods of diagnosis                        | 10. Retina and vitreous                                |
| 2. Therapeutics and operations                         | 11. Optic nerve and toxic amblyopias                   |
| 3. Physiologic optics, refraction, and color vision    | 12. Visual tracts and centers                          |
| 4. Ocular movements                                    | 13. Eyeball and orbit                                  |
| 5. Conjunctiva   | 14. Eyelids and lacrimal apparatus                     |
| 6. Cornea and sclera                                   | 15. Tumors   |
| 7. Uveal tract, sympathetic disease, and aqueous humor | 16. Injuries   |
| 8. Glaucoma and ocular tension                         | 17. Systemic diseases and parasites                    |
| 9. Crystalline lens                                    | 18. Hygiene, sociology, education, and history         |
|  | 19. Anatomy, embryology, and comparative ophthalmology |

### 1

#### GENERAL METHODS OF DIAGNOSIS

Krimsky, Emanuel. **Portable slit-lamp and its clinical value.** Arch. of Ophth., 1943, v. 30, Aug., pp. 263-265.

The instrument consists of a monocular loupe to which is attached a light source. The light is furnished by a small globe powered either by dry cells carried in the pocket or by a cord from the house circuit. The light is focused so as to provide either a vertical or horizontal slit or a circular zone of light. The slitlamp is so light that it may be attached to the physician's eye glass, leaving both hands free. (3 figures.)

John C. Long.

### 2

#### THERAPEUTICS AND OPERATIONS

Bellows, J. G., and Gutman, M. **Application of wetting agents in ophthalmology.** Arch. of Ophth., 1943, v. 30, Sept., pp. 352-357.

It has been shown that the sulfonamide compounds, with the exception of

sulfanilamide, penetrate the cornea poorly. One of the authors has previously stated (Amer. Jour. Ophth., 1943, v. 26, p. 990) that a marked increase in the penetrability of the sulfonamide compounds may be obtained through the use of a wetting agent. A wetting agent is defined as a substance which by lowering interfacial tension increases penetration and acts as a detergent or emulsifying agent or in some other way manifests surface activity. It consists of molecules containing a polar and a nonpolar group. As a result the molecules concentrate on the surface of the cornea and orient themselves so that the polar group is in contact with the epithelium and the nonpolar portion is directed outward to the surrounding media. Consequently, the interfacial tension between the surrounding media and the epithelium is decreased, bringing about increased penetration of the wetting agent and of other substances which would not by themselves penetrate readily. Incidentally, wetting agents have been shown to possess bactericidal powers.

The wetting agents used were aerosol OT, aerosol OS, tergitol (4, 7), tergitol 08, ocnol KD, sodium lauryl sulphate, and zephiran. The tables show that penetrability was increased 2 to 15 times by these wetting agents.

The authors next conducted a group of miscellaneous experiments to determine the effect of other factors superimposed on the influence of the wetting agents in conjunction with the sulfonamide compounds. Application of both local and systemic heat caused a three-fold increase in the concentration of the drug in the aqueous humor of the control eyes. In the eyes treated with wetting agents, the already high value for the penetration of sulfathiazole was increased with local heat by 50 percent and with systemic heat 75 percent. The influence of vasodilatation produced by inflammation following infection with hemolytic streptococci in the vitreous chamber or by injection of mecholyl chloride and histamine was also studied. Like heat, infection caused a three-fold increase in the penetration of sulfathiazole in the control eyes, whereas with wetting agents the already high penetration was increased by about 50 percent.

It appears that in the case of sulfanilamide, which by itself penetrates more readily than the other agents, the increase noted is not of great practical significance. On the other hand, with sulfathiazole, sulfapyridine, and sulfadiazine, which by themselves penetrate poorly, a wetting agent is essential for bringing about a therapeutically effective concentration. The wetting agents themselves produced no obvious untoward effects when used constantly for ninety minutes in the recommended concentrations and in the form of a paste. (4 tables, charts, references.)

Ralph W. Danielson.

Ellis, F. A. Possible danger in use of merthiolate ophthalmic ointment. *Arch. of Ophth.*, 1943, v. 30, Aug., pp. 265-266.

Two cases of severe dermatitis from the use of tincture of merthiolate are reported. Both patients also showed skin hypersensitivity to merthiolate ophthalmic ointment. A severe stomatitis resulted from application of the drug to the inner surface of the cheek, indicating that mucous membranes may share in the sensitivity reaction. Although the author has found no reported cases of ocular hypersensitivity, there is a distinct possibility of ocular damage from the use of merthiolate ointment in the eyes of hypersensitive patients.

John C. Long.

### 3

#### PHYSIOLOGIC OPTICS, REFRACTION, AND COLOR VISION

Hicks, A. M. Aniseikonia. A review of 200 consecutive cases examined on the eikonometer. *Arch. of Ophth.*, 1943, v. 30, Sept., pp. 298-311; also *Trans. Pacific Coast Oto-Ophth. Soc.*, 1942, 30th mtg.

In this study the only patients subjected to examinations with the eikonometer were those who had not been relieved of their symptoms by wearing lenses to correct their refractive errors or muscle imbalances. All had undergone one or more physical and laboratory examinations, with negative results. Thus, the patients who form the basis of this report were physically sound persons who had continued to suffer from headache, pain in the eyes, ocular fatigue, and other symptoms of eyestrain, in spite of wearing spectacle lenses which were considered to be adequate.

There are three types of aniseikonia:

the over-all difference, the meridional size difference, and a combination of the two. Most of the measurements have been made in the 90- and 180-degree meridians. It is possible that meridional aniseikonia at oblique axes may exist in some cases, but a satisfactory clinical method has not yet been developed to determine the axis of oblique meridional aniseikonia. This limitation probably accounts for failures in some cases.

The measurement of aniseikonia is entirely subjective and requires close attention on the part of the patient. Common difficulties encountered in making the examination are poor peripheral fusion, suppression, and uncertainty in observation.

In Hicks's experience no person with less than 1 percent size-difference received relief from correction of his aniseikonia, and the author feels that the chance of success is much greater if the amount of aniseikonia is 1.5 percent or more. The maximum amount compatible with single binocular vision is about 5 percent. The sensitivity of the patient in recognizing size differences varies, but for an average person with 20/20 vision it is in the magnitude of 0.25 percent.

Of the 86 patients in whom 1 percent or more of size difference was found, 39 reported a lessening or complete relief of symptoms while wearing temporary lenses with the necessary size correction added by means of a hook front. At the time of writing, 31 patients were still wearing temporary glasses. Permanent iseikonic lenses were prescribed only for those persons who reported relief of symptoms from wearing temporary glasses.

Various groups of cases are discussed. Several case reports are then given in detail to illustrate each group

and interesting comments are made on each case. (References.)

Ralph W. Danielson.

Holmes, W. J. Night vision. *Arch. of Ophth.*, 1943, v. 30, Aug., pp. 267-277.

The ability of the eye to see under conditions of low brightness is a function of the retinal rods and is called scotopic vision. Subjectively, objects seen under these conditions are devoid of color except for slight tinges of blue and violet. Scotopic vision is a function of the peripheral retina, the macula being relatively insensitive in dim light. The transition between scotopic and photopic (cone) vision occurs at approximately the illumination of full moonlight. The eye is capable of functioning over an enormous range of light intensities, thus the ratio in brightness between summer sunlight and dim starlight is about 100,000,000 to 1. The immediate effect of an abrupt decrease in light intensity is a reduction in visual acuity. The peripheral retina rapidly becomes more sensitive for approximately ten minutes. There is then a gradual increase in sensitivity up to forty minutes, when a maximum is attained.

The visibility of objects viewed in dim light is affected by size, brightness, color, contrast with surroundings, and duration of the stimulus on the retina. Some of these factors are capable of accurate determination. Ocular and general conditions influencing vision in dim light include refractive errors, size of pupil, condition of the crystalline lens, and the state of the retina and optic nerve. Vitamin-A deficiency is discussed. Various deleterious effects of dim lighting are discussed, particularly in connection with war black-outs. Methods of examining

visual acuity under conditions of low illumination are described. The review includes a short series of definitions of lighting terms. (Bibliography.)

John C. Long.

Lewis, S. D., and Mandelbaum, J. *Achromatopsia*. *Arch. of Ophth.*, 1943, v. 30, Aug., pp. 225-231.

Achromatopsia, or complete color blindness, is a relatively rare anomaly, apparently due to either absence or deficiency of function of the cone cells. Color blindness is discussed according to the concepts of the Thomas Young triceptor theory of color vision. Two sisters and a brother were observed with complete achromatopsia. All colors were referred to as gray. All three had nystagmus and central scotomata with very defective central vision. From the history a family tree of the condition is charted. Apparently the hereditary pattern is that of a simple recessive characteristic, without sex linkage. Two of the subjects were studied with the Helmholtz color-mixer to determine the relative brightness of spectral colors. The data for both of the subjects fitted the scotopic curve fairly well, indicating only rod function. Dark-adaptation figures did not differ greatly from those of the normal range, showing two distinct curves. The presence of two curves is usually attributed to the functioning of both rods and cones. One may postulate from the existence of double curves that there may be two types of rod cells. (3 figures, references.)

John C. Long.

Morgan, M. W., Jr., Mahoney, J., and Olmstead, J. M. D. *Astigmatic accommodation*. *Arch. of Ophth.*, 1943, v. 30, Aug., pp. 247-249.

The authors have refracted a num-

ber of different animals under experimental conditions, largely by skiascopy but also by photography of the Purkinje-Sanson images and the profile of the cornea and the lens. It was found that accommodation was reciprocally controlled by the parasympathetic and sympathetic nervous systems. Stimulation of the cervical sympathetic nerve produces an increase in hypermetropia; whereas when the oculomotor nerve is stimulated the eye becomes more myopic. It was further observed that stimulation of the cervical sympathetic nerve produced an astigmatism which averaged over 1.00 D. After excluding other factors, it was concluded that the astigmatism was produced by a differential flattening of the lens. If these observations are applicable to human beings, it seems that action of the sympathetic system may cause a change of axis of astigmatism during active positive accommodation. (One table, 7 illustrations.)

John C. Long.

Wescott, Virgil. *Concerning the accommodation before and after head injury*. *Illinois Med. Jour.*, 1943, v. 83, March, p. 170.

In 57 patients who had had no difficulty before injury, Wescott reports that after head injury there was an inability to read with comfort for even a reasonable length of time.

Theodore M. Shapira.

#### 4

#### OCULAR MOVEMENTS

Pascal, J. I. *On convergence tests*. *Amer. Jour. Ophth.*, 1943, v. 26, Sept., pp. 967-969.

Sugar, H. S. *Paradoxic esotropia during cycloplegia*. *Arch. of Ophth.*, 1943, v. 30, Aug., pp. 259-261.

Four patients were encountered in whom an esotropia either developed or increased while under a cycloplegic. Every one of these patients had previously had some muscle disturbance, with partial amblyopia in one eye. In each case the dominant eye was mildly hyperopic. It was found that a pin-hole disc or fully correcting lens over the fixing eye did away with the esotropia.

This phenomenon appears to substantiate the presence of two types of accommodation-convergence relationship, an involuntary (occipital) and a voluntary (frontal). In high hypermetropia the occipital accommodative mechanism is insufficient, so the frontal must also be called into play. As the frontal mechanism is closely associated with convergence, an accommodative esotropia results. In the cases of paradoxical esotropia it is assumed that, as the hyperopia is not very great, an attempt is made to focus by using the frontal mechanism. The excessive accommodative effort made by this mechanism results in esotropia. A person with normal binocular vision will not develop esotropia because it is inhibited by the diplopia which would result. (4 photographs.)

John C. Long.

Walsh, F. B. **Certain abnormalities of ocular movements.** Bull. New York Acad. Med., 1943, v. 19, April, p. 253.

The author describes the mechanism which initiates and controls conjugate movements of the eyes; including volitional control of conjugate ocular movements by the frontal lobes, optic-fixation reflexes originating from the occipital lobe, and the labyrinthine, semicircular-canal, otolith, and neck reflexes. Lesions involving the frontal lobe produce when destructive a rela-

tive increase in optic-fixation reflexes and conjugate deviation to the side of the lesion, and to the opposite side when irritative.

The following maneuvers aid in the diagnosis of supranuclear lesions: The patient is asked to fixate and follow a light moved in front of his eyes. (1) With pronounced deviation of eyes and head to right, the voluntarily impossible movement of the eyes may in some cases be obtained by having the patient fix on a test object moved slightly from his right to his left (the "following movement"). (2) While the patient fixes the light the head is rotated by the examiner in the appropriate direction, when the eyes may move into the desired field. (3) The light is held in the seemingly unobtainable field, when in some instances the eyes are immediately turned toward the light. (4) The patient's head is grasped by the examiner and is rapidly rotated, when it may be found that the eyes deviate momentarily into the position desired by the examiner. This is thought due to reflexes arising from the semicircular canals. (5) If when the eyes are deviated to the right the left ear is irrigated with cold water, the eyes move conjugately to the left, providing the paralysis of ocular movement is supranuclear in origin and originates from a lesion in the hemisphere, and further providing the vestibular pathways are intact.

Lesions involving the posterior oculogyric apparatus result in inability to properly fixate objects with the eyes. When reading, the patient is unable to start the next line. Accommodation-convergence is affected, and he cannot fixate an object but can converge on his own fingers. Stereoscopic vision is lost, and the patient does not know whether an object moves toward or

from him. The visual acuity is often lowered and field defects are often present. The volitional movements of the eyes, however, are unimpaired.

In Parinaud's syndrome, with lesions in the midbrain or in the pineal gland, there is loss of ability to elevate and depress the eyes voluntarily. But when the eyes are fixing and the patient's head is slowly flexed the eyes may turn upward, or when the head is slowly extended the eyes may move downward. The presence of Bell's phenomenon may prove the supranuclear origin of the paralysis. The patient is asked to close his eyes, while the lids are held open by the examiner. If Bell's phenomenon is present the eyes will turn upward. While the head is held flexed, caloric stimulation of the ears may cause the eyes to turn upward.

During regeneration of an injured nerve there is multiplication of nerve fibers. These fibers become misdirected or mixed in their distribution. The misdirection of regenerated fibers in the third nerve results in anomalous movements of the upper lid, abnormalities of movements of the globe, and pupillary anomalies. R. Grunfeld.

## 5

### CONJUNCTIVA

Bach, E. C. Epidemic keratoconjunctivitis. *Wisconsin Med. Jour.*, 1943, v. 42, April, p. 415. (See Section 6, Cornea and sclera.)

Fritsche, T. R. Staphylococcic conjunctivitis. *Minnesota Med.*, 1943, v. 26, March, p. 263.

The conjunctivitis caused by staphylococci is a stubborn variety, varying from acute forms to mild chronic types. It tends to recur and to become chronic. It is probably the most fre-

quent cause of catarrhal ulcers. The diagnosis should be confirmed by cultures. Sulfathiazole and the staphylococcic vaccines and toxoids are helpful in treatment. (References.)

Gertrude S. Hausmann.

Lewy, R. B. Allergic conjunctivitis from colored ink. *Arch. of Ophth.*, 1943, v. 30, Sept., p. 376.

A soldier complained of recurring attacks of conjunctival injection. His history pointed to colored comic newspapers as the offending agent. This was proved by applications of such material to the conjunctiva. It is of interest that the skin was not sensitive.

Ralph W. Danielson.

Sitschevska, O., and Sedam, M. Primary tuberculosis of the conjunctiva. *Arch. of Ophth.*, 1943, v. 30, Aug., pp. 196-206.

Primary tuberculosis of the conjunctiva is a rare lesion involving the conjunctiva and regional lymph glands. The disease occurs typically in youth and usually runs a favorable course, although there have been cases of loss of the eye and of death from extensive tuberculous involvement.

The authors report a case of primary conjunctival tuberculosis in a boy of 18 months. The child showed ptosis of the left lid with marked conjunctival follicles and granulations. The left preauricular and submental and one cervical gland were greatly swollen and soft. Aspiration of each of these three glands produced pus containing tubercle bacilli. An ulcer, surrounded by granulations, formed on the superior tarsal conjunctiva. Biopsy from this region showed a typical tuberculous reaction and tubercle bacilli could be demonstrated in the tissues. The conjunctiva healed quickly after

the biopsy and after application of mild local medication. The lymph glands responded well to aspiration and fractional X-ray therapy. General medical care consisted of a high-vitamin diet and plenty of outdoor air and sunshine. When examined a year later there was only a faint conjunctival scar and slight scarring over the preauricular gland. At no time was there evidence of tuberculosis elsewhere. (2 photographs, 2 photomicrographs.) John C. Long.

Weiss, Charles. Bacteriologic observations on infections of the eye. *Arch. of Ophth.*, 1943, v. 30, July, pp. 110-137.

With the development in recent years of a variety of sulfonamide compounds and specific bactericidal and antitoxic serums for the treatment of infections of the eye, the etiologic diagnosis of diseases of the conjunctiva and cornea has become essential. This is especially true because, except those of syphilis, diphtheria, and gonorrhea, there are very few constant or absolutely typical clinical pictures corresponding to individual infections. Moreover, as indicated hereafter, a bacteriologic diagnosis is of importance in the epidemiologic control of transmissible ocular disease. The author thought it desirable, therefore, to record the results of examinations conducted during the past few years in the clinical and research laboratories of the Mount Zion Hospital in San Francisco and to summarize observations on the commoner infections of the eye as reported in the literature.

Under technical procedures Weiss stresses the fact that much better smears will be made if the eye is anesthetized and material for cultures and smears obtained by scraping the epithelium of the bulbar, palpebral,

tarsal and retrotarsal conjunctivas with a platinum spatula. It is necessary to withhold treatment with germicides for at least 24 hours prior to such examination. The ophthalmologist is reminded that final bacteriologic reports cannot be made on the basis of stained smears alone. Fermentation and serologic tests and animal inoculations are necessary for final identification of microorganisms. Even in the cases of the gonococcus and the Morax bacillus, diagnosis by smear is of only presumptive nature. The darkfield condenser is of value when one is searching for spiral organisms. Inoculation of guinea pigs with bits of tissue or with secretions is indicated when oculoglandular tularemia, brucellosis, or tuberculosis is suspected. Serologic reactions are important in syphilis, tularemia, and brucellosis. The complement-fixation test is used in the diagnosis of gonorrhea. Reference is made to the tuberculin, the brucellin and the Free cutaneous test, which are useful as aids in the diagnosis of tuberculosis, brucellosis, and lymphopathia venerea, respectively.

Factors governing the resistance, immunity, and infection of the conjunctiva and cornea are discussed. Ordinarily, during the course of conjunctivitis, bacteria may lodge and multiply on the cornea without producing evidence of keratitis. Any of a number of virulent and toxin-producing microorganisms may, however, invade the cornea and produce severe damage; among these are the gonococcus, the pneumococcus, and several viruses.

Gonorrheal ophthalmia is now becoming one of the rarer causes of conjunctivitis of the newborn. The incidence of gonorrheal and inclusion-body blennorrhea varies greatly in

various locations. Inclusion conjunctivitis is a distinct clinical entity, characterized by a period of onset of from five to ten days after birth, a duration of from three to four months, only rare complications, and the presence of cytoplasmic inclusion-bodies in the conjunctival epithelial cells.

The bacterial flora in the commoner infections of the conjunctiva and eyelids vary with the geographic location and occupation of the patient. They also seem to change from generation to generation, as sanitation, nutrition, and bacteriologic technique improve.

From experience in bacteriologic examination of the conjunctiva prior to intraocular operations at Mount Zion Hospital the author says it has been the policy to advise postponement of an operation in the presence of half a dozen or more colonies of hemolytic, toxigenic staphylococci, or two or more colonies of hemolytic streptococci, pneumococci, or pyocyanic bacilli. A long list of offending organisms have been named for the bacterial infections following intraocular operations and in infections of the cornea. Considerable attention has been given of late to bacteria and viruses in epidemics of conjunctivitis and keratoconjunctivitis, especially "shipyard conjunctivitis."

Many organisms have been reported in infections of the lacrimal apparatus, and in iritis, uveitis, iridocyclitis, choroiditis, and panophthalmitis. The author says that he has been unable to confirm the theory that sympathetic ophthalmia is essentially a tuberculous uveitis occurring in a person whose eye is injured at a time when he has tubercle bacillemia. Mycotic and virus infections of the eye are discussed. (5 figures, 9 tables, extensive bibliography.)

Ralph W. Danielson.

## 6

## CORNEA AND SCLERA

Brown, E. H. Therapeutic experiences with corneal ulcers due to *bacillus pyocyaneus*. Arch. of Ophth., 1943, v. 30, Aug., pp. 221-224.

Ulceration of the cornea due to the pyocyaneus organism is recognized as a very dangerous condition. The author reports three cases of this disease, all following removal of corneal foreign bodies. Two of the ulcers resulted in enucleation and the third healed with considerable scarring and final vision of 10/400. From the experience gained in the treatment of these cases the author concludes that early use of actual cautery or the diathermy needle is of value. Sulfapyridine or sulfanilamide should be administered by mouth. The Saemisch maneuver is indicated if the ulcer continues to progress. (References.) John C. Long.

Gallardo, Edward. Primary herpes simplex keratitis. Arch. of Ophth., 1943, v. 30, Aug., pp. 217-220.

Herpes virus, either latent or active, is present in from 80 to 90 percent of the adult population. It is often carried in a dormant state in the epithelium of the mouth, conjunctiva, or sexual organs, and perhaps also in nerve tissue. Recurrent attacks of the disease may be precipitated by a wide range of conditions.

Five patients, having no previous history of any type of herpetic disease, were seen with severe attacks of herpetic keratitis. Intracerebral inoculation into mice of scrapings from the lesions produced death from typical herpetic encephalitis. Titrations of the patients' sera with virus which had been recovered from the mouse-brain suspensions showed no herpes-neutralizing antibodies during the first few



days of the keratitis but did show antibodies after 16 to 18 days. Seventeen additional cases of herpes keratitis showed strong antibodies in the serum when first admitted. All of these patients had had one or more cutaneous herpetic attacks prior to the ocular involvement.

Typical herpetic keratoconjunctivitis was produced in rabbits by dropping or swabbing virus material into their conjunctival sacs without any scarification or other trauma. The incubation period was somewhat longer than when trauma accompanied the inoculation. (3 tables, references.) John C. Long.

Gifford, S. R., Puntenney, I., and Bellows, J. Keratoconjunctivitis sicca. Arch. of Ophth., 1943, v. 30, Aug., pp. 207-216.

Forty-nine patients have been observed with deficiency of the lacrimal secretion. These patients have been divided into three groups based on the severity of the deficiency and of the symptoms. Twelve of the patients showed a typical Sjögren syndrome with almost no lacrimal secretion, but with marked corneal and conjunctival changes and usually a deficiency in salivary secretion. Lacrimal deficiency was also observed in neuroparalytic keratitis and pemphigus and after removal of the lacrimal gland. The technique of applying the Schirmer test is given in detail. The author has found this test quite satisfactory in determining lacrimal deficiency. The milder cases improved and were quite comfortable when using gelatin and Locke's solution as a substitute for tears. The more severe cases required closure of the tear points. Methods of permanent closure of the tear points are discussed. (2 illustrations, 5 tables.)

John C. Long.

Haessler, F. H. Diagnosis of corneal lesions. Minnesota Med., 1943, v. 26, March, p. 243.

In diagnosing corneal lesions, the following manifestations are important: (1) changes in size and shape, (2) the presence of pigment, (3) the presence of blood vessels, (4) modification of transparency. In megalocornea, most important is the decision whether the large cornea is a manifestation of gigantism or the result of juvenile glaucoma. In microcornea it is important to remember that 20 percent of cases of microcornea develop glaucoma. Keratoconus begins near the end of the first decade of life. The most frequent pigmentations are Stähli's line, the hemosiderin of keratoconus, and the Kayser-Fleischer deposit in Wilson's disease.

The presence of vessels gives some information as to the length of time the corneal disease has existed. It takes at least six weeks to develop pannus. Diseases of the corneal epithelium are superficial punctate keratitis, dendritic keratitis, recurrent erosion, filiform keratitis, edema and bullous keratitis, epithelial dystrophy, xerophthalmia, lagophthalmia, and keratitis neuroparalytica. Lesions involving Bowman's membrane and the superficial stroma include siderosis, trachoma, rosacea keratitis, vernal catarrh, serpent ulcer, annular ulcer, ring abscess, marginal ulcer, rodent ulcer, subepithelial striation from hypotony, familial dystrophies, and band keratitis. Lesions of the deepest stromal lamellae and of Descemet's membrane are parenchymatous keratitis, keratitis annularis, disciform keratitis, and deep pustuliform keratitis. (6 illustrations.)

Gertrude S. Hausmann.

Turner, N. H. Keratitis marginalis

superficialis. *Virginia Med. Monthly*, 1943, v. 70, Feb., p. 109.

The author reports a case with acute symptoms and complete recovery.

Theodore M. Shapira.

## 7

### UVEAL TRACT, SYMPATHETIC DISEASE AND AQUEOUS HUMOR

Givner, Isadore. Bilateral uveitis, poliosis, and retinal detachment, with recovery. *Arch. of Ophth.*, 1943, v. 30, Sept., pp. 331-337.

Harada, in 1926, first reported a disease with a typical onset of acute diffuse exudative choroiditis or uveitis and bilateral detachment, accompanied by poliosis, and sometimes alopecia and deafness, with a relatively favorable prognosis for spontaneous retinal reattachment.

After a résumé of the literature, the author reports a case in great detail. An interesting feature was that the attack seemed to have been precipitated by lead poisoning. Cultures were negative. The detachment, Koeppe nodules, and iridocyclitis may have resulted from an allergic reaction to bacterial proteins. Bilateral iridectomies and sclerectomies were successful in controlling the tension and quieting the process.

The case was similar to the Vogt-Koyanagi syndrome, which sometimes includes alopecia, poliosis, vitiligo, and dysacusia. The similarity of Harada's disease pathologically to sympathetic ophthalmia and Vogt-Koyanagi disease suggested the cutaneous testing with uveal pigment. (5 figures, references.)

Ralph W. Danielson.

Hess, Leo. Epinephrine mydriasis. *Arch. of Ophth.*, 1943, v. 30, Aug., pp. 194-195.

Instillation of epinephrine hydrochloride (1 to 1,000) into the conjunctival sac of the normal individual results only in slight dilatation of the pupil. Marked to maximal dilatation of the pupil may occur with this drug in patients with diabetic coma, hyperthyroidism, chronic hypertensive disease of the kidney, and some types of glaucoma, and after lesions of the sympathetic fibers between the superior cervical ganglion and the iris. The dilatation in diabetic coma is so definite as to make it a valuable diagnostic sign. Epinephrine mydriasis is probably indicative of some lesion of the third neuron in the sympathetic pathway of the pupil. This third neuron originates in the superior cervical ganglion and enters the cranium with the internal carotid artery. These neurons form the cavernous plexus, from which they continue to the dilator muscle of the iris, partially in the long ciliary nerve and partially in the short ciliary nerve, without being interrupted in the ciliary ganglion. (References.)

John C. Long.

## 8

### GLAUCOMA AND OCULAR TENSION

Bothman, Louis. Pathological findings in eyes enucleated for glaucoma due to sarcoma of the uvea. *Illinois Med. Jour.*, 1943, v. 83, March, p. 173.

Bothman suggests that no decompression operation be done in blind painful eyes where the cause of the secondary glaucoma is unknown. Such an eye may contain a sarcoma. Enucleation is the operation of choice in such cases. Theodore M. Shapira.

Rados, Andrew. Blood cholinesterase values of patients with glaucoma. *Arch. of Ophth.*, 1943, v. 30, Sept., pp. 371-375.

Loewi and his co-workers have proved that the effects of stimulation of the vegetative nervous system are transmitted to the effector organs through humoral channels; and that stimulation of the cardiac branch of the vagus nerve gives rise to a vagotropic substance, likewise liberated by stimulation within the sympathetic and parasympathetic nervous systems; and that the liberated substance in all probability represents acetylcholine.

Acetylcholine is rapidly inactivated through hydrolytic splitting into choline and acetic acid through the esterase. The enzyme is present in the blood and in various organs and tissues. It has been proved that physostigmine, which potentiates the action of the vagus nerve, inhibits the enzymatic decomposition of the so-called vagus substance and acetylcholine. The discovery of acetylcholine has suggested the possibility that it assists in the regulation of the intraocular pressure. The tension-reducing property of physostigmine is due to accumulation of acetylcholine in consequence of the inhibition of esterase activity.

The present paper reports on the determination of cholinesterase in the blood in cases of glaucoma. The author says that of 61 unselected patients with glaucoma, 59 had blood cholinesterase values between 40 and 120 cu. mm., that is, within the normal range. The majority had high normal values. Of the 12 patients with acute glaucoma, only 2 had comparatively low values; the remaining 10 had values which were toward the upper limit of normal. It must be borne in mind that the normal values present a fairly broad band, and caution must be exercised in interpretation, especially in view of the additional fact that many conditions are likely to influence blood cholinesterase.

Such conditions are hyperthyroidism, anemia, carcinomatosis, cachexia, sepsis, subacute bacterial endocarditis, pneumonia, and ulcerative colitis. In evaluation of blood-cholinesterase levels of patients with glaucoma, such conditions must be excluded. (References.)

Ralph W. Danielson.

## 9

### CRYSTALLINE LENS

Salit, P. W. Mineral constituents of sclerosed human lenses. *Arch. of Ophth.*, 1943, v. 30, Aug., pp. 255-258.

It has previously been determined that the mineral constituents of cataractous lenses vary considerably from those of normal lenses and that the changes become more marked with the advance of the cataract. In this study the author has determined the effects of sclerosis on the composition of the lens. Seventy-two lenses in varying degrees of sclerosis, all extracted by the intracapsular technique, have been examined. The average weight of the lens decreased at a rather uniform rate from 0.2221 gm. for practically normal lenses to 0.1935 gm. in highly advanced sclerosis. In spite of this decrease in weight, the water content of the lenses increased from 67.6 to 75.4 percent. Potassium and phosphorus decreased from 14.82 and 10.34 percent in practically normal lenses to 3.52 and 4.17 percent in very advanced sclerosis. Sodium, calcium, and chlorine increased from 7.91, 0.45, and 2.06 percent in practically normal lenses to 26.54, 2.65, and 18.06 percent in sclerosis. Apparently there was some increase in sulphur content with advancing sclerosis. (4 tables, references.)

John C. Long.

## 10

## - RETINA AND VITREOUS

Cerboni, F. C. Obstruction of the central vein of the retina. *Rev. Oto-Neuro.-Oft.*, 1941, v. 16, Oct., p. 250, Nov., p. 279, and Dec., p. 109.

This study, which occupies the major part of three numbers of the *Revista*, was presented as a Doctor's thesis at Buenos Aires 1941. Thrombosis of the central vein of the retina, recognized as a nosologic entity since the end of the last century, has formed the motive of important works and studies on the part of many authors. From these and from a few personal case reports the candidate has extracted the material for his thesis in which he presents a summary, or compilation, but disclaims originality. He adopts as his title "obstruction" instead of "thrombosis" of the retinal vein, noting that the term "obstruction" more clearly denotes the characteristics of the picture than does "occlusion," for it may occur in cases in which the lumen of the vein has not totally disappeared. The term "occlusion" is reserved for complete obstruction.

The subject is treated with thoroughness, beginning with the physiology of the retina and its vessels, continuing with the symptomatology of obstruction, the evolution of the disease, differential diagnosis, etiology, pathogenesis, therapy, and prognosis. The local treatment may be directed toward three effects: (1) to treat the cause of the endovascular lesion where the thrombus is likely to occur; (2) to modify the state of the thrombus by its dissolution and thus, (3) improve the circulation of the eye with the object of moving the thrombus and promoting the survival of the nervous elements of the retina. In the treatment of the dreaded

complication, hemorrhagic glaucoma, surgery alone is said to be possible. Repeated paracentesis of the anterior chamber has given relief in some cases, and fistulizing operations have sometimes made it possible to avoid enucleation. Iridectomy has given bad results in general.

The third and last division of the paper is devoted to a careful study of four personal cases. This thesis is thorough and comprehensive and may be read with benefit by any ophthalmologist who wishes to review the subject. (15 retinograms.)

Jerome B. Thomas.

Falls, H. F. Lipaemia retinalis. *Arch. of Ophth.*, 1943, v. 30, Sept., pp. 358-361.

In the cases reported the majority of the patients were either in or on the verge of coma when first seen. The condition is predominantly a disease of young diabetic patients, rarely being found in patients over 30 years.

An increase in plasma lipid is associated with a large variety of clinical entities: pneumonia, peritonitis, alcoholism, phosphorus poisoning, asphyxia, starvation, xanthomatosis, carcinoma, tuberculosis, and trench nephritis. It is only in diabetes mellitus, as a rule, that the plasma lipid becomes emulsified in sufficient quantity to be seen in the blood stream with the aid of the ophthalmoscope. An increase in the plasma lipid is not in itself sufficient to produce retinal lipemia; emulsification of the lipid is necessary. Acidosis is necessary to the phenomenon of emulsification. The pathologic color and appearance of the retinal vessels are seen to originate in the remote periphery, gradually advancing toward the optic disc. Other than an occasional retinal hemorrhage, no abnormal fundoscopic changes have been observed.

The case reported here is of interest for several reasons. Only one other case has ever been reported where the age of the patient was over sixty years. The combination of severe emaciation, starvation, pneumonia, diabetes mellitus, infarct of the kidney, pulmonary abscesses, and xanthomatosis is worthy of attention in that each alone may effect an elevation of the plasma lipid. Since the disease is usually present only in young patients with severe diabetes, associated severe systemic complications are probably requisite to its manifestation in older patients, with milder diabetes. (References.)

Ralph W. Danielson.

Greear, J. N. Rupture of aneurysm of circle of Willis. *Arch. of Ophth.*, 1943, v. 30, Sept., pp. 312-319.

The author gives a review of the cases reported and quotes Cushing as saying that an aneurysm should always be considered in a differential diagnosis when an apoplectic attack is followed by symptoms pointing to the region of the internal carotid artery in its intracranial portion. Should there be, in addition, subhyaloid retinal hemorrhages and should the cerebrospinal spaces be found to contain free blood, a diagnosis would be reasonably certain.

The various theories as to the modes of production of intraocular hemorrhages are reviewed. One school of thought holds that the retinal hemorrhages are due to direct leakage of blood from the sheath through the lymphatic spaces at the sides of the lamina cribrosa. Other authors maintain that the cause of the intraocular hemorrhage in such cases is obstruction of the central vein of the retina at the point where it leaves the optic nerve and enters the dural sheath. The mecha-

nism of the production of hemorrhage would, therefore, be the same as that for papilledema due to increased intracranial pressure. A case report including postmortem and histopathologic examination seems to bear out the latter contention. (4 figures, references.)

Ralph W. Danielson.

Lewis, P. M. Angiomatosis retinae. *Arch. of Ophth.*, 1943, v. 30, Aug., pp. 250-254.

Angiomatosis retinae is a relatively rare condition which runs a fairly typical course. At first there is marked vascular dilatation with the formation of the angioma. Later, exudates and hemorrhages occur and lead to massive exudates and retinal detachment. Finally secondary glaucoma arises and the eye is enucleated. Approximately 25 percent of the cases are associated with intracranial angiomatous cysts (Lindau's disease). As angiomatosis of the retina is a progressively destructive condition, radical methods of treatment are justified. Destruction of the angioma and of accompanying vessels by diathermy is recommended.

The author reports a case in a man of 25 years. Vision was reduced to 8/200, largely because of macular exudates. An angioma about one disc diameter in size was seen near the ora serrata. The lesion was localized as one would localize a tear in retinal detachment. The angioma and accompanying vessels were destroyed by diathermy micropins inserted through the sclera. The result was that the angioma and the surrounding area were replaced by scar. Vision did not improve but the eye has had a normal appearance and normal tension. A year has passed since the surgery and no other angiomas have developed. (2 illustrations, references.)

John C. Long.

Lijo Pavia, J. Detachment of the retina. *Rev. Oto-Neuro-Oft.*, 1941, v. 16, Aug.-Sept., p. 205.

This paper was presented at the Fourth Brazilian Congress of Ophthalmology (Rio de Janeiro). It begins with the statement that detachment of the retina, lacking logical and rational treatment until 1929, became during the following decade a disease curable in 50 to 70 percent of the cases treated. The writer gives a brief review of the development of etiology and treatment from the first report of Gonin to the present time. Noting the serious difficulties involved in comparing the percentages of end results obtained by different authors using different methods, he regards it as essential for authors reporting cases to answer the following questions: (1) Are the cases selected? (2) What do you mean by a cure? (3) How long has the cure lasted? (4) How many cases have you operated upon? He regards the presence of a tear in retinal detachment as practically certain and quotes his own statistics of ten years duration as showing a tear in 90 percent of 70 observations including old, medium, and recent cases of detachment. In sixty patients with 73 retinal tears, 37 of the tears were found in the upper-outer quadrant, 15 in the lower-outer and the remainder in various other locations. As to the cause of the retinal tears myopia was found to be a predominant factor, having been present in more than 50 percent of the cases. The traumatic episodes reported by the patients were all of sufficient violence to explain the lesion. In considering the probability of success the author gives a long list of factors including age, extent of the detachment, and number and situa-

tion of tears; and he optimistically sums up by stating that if the patient were young, with a discrete flat detachment and a single accessible tear, one could give as high as 95 percent probability of cure. He advises against surgical treatment in cases of diabetes, retinopathies of renal origin, hypertensive retinosis, or that caused by cellulitis, scleritis, or exudative choroiditis. Authors in general, including the writer, regard as a "cure" (a) the recovery of visual acuity equal to at least 1/10, or (b) proof of complete reapplication of the retina and enlargement of the visual field. Among 60 operated cases Lijo Pavia reports 39 with complete reattachment and 21 failures. In answer to the question as to how long the detachment has remained cured the author reports that in his series of 39 favorable cases the retina remained in place for a period of 1 year after operation in 21 cases, 1 to 2 years in 7 cases, 2 to 3 years in 4 cases, 4 to 5 years in 3 cases, and 6½ years in 1 case. In comparing the results of operative methods it has been estimated that the successes in unselected cases vary between 34 and 46 percent; and that in uncomplicated cases the cures increase to between 53 and 66 percent. Of a total of 60 cases operated upon by various methods the writer used diathermy-puncture accompanied by superficial application of diathermy in 46 cases with 34 successes and 12 failures. Other cases treated earlier by galvanocautery or by chemical cauterization gave 5 successes and 9 failures. The paper is illustrated by 20 excellent retinographs, several of them grouped effectively in panoramic arrangement. (References.) Jerome B. Thomas.

Rosenthal, C. M., and Guzek, J. T. Thrombosis of central retinal vein suc-

cessfully treated with heparin. Arch. of Ophth., 1943, v. 30, Aug., pp. 232-235.

Thrombosis of the central retinal vein is a grave ocular disaster usually resulting in severe visual loss and often in loss of the globe through hemorrhagic glaucoma. Several cases have been reported in which recovery followed administration of heparin. The authors present two cases of complete thrombosis of the central vein with ultimate recovery and 6/6 vision in each patient. One received a total of 1,800 mg. of heparin in ten days. The other was given 250 mg. of the preparation daily for six days. One of the remarkable features of the cases is that treatment was not started until five weeks in one instance and three weeks in the other after onset of the condition. Heparin possibly prevents further increase in the thrombotic process, thus permitting greater canalization and resumption of the normal function of the vein. (References). John C. Long.

Sverdlick, José. Observations on the structure of the retinal cells. Archivos de Histologia Normal y Patologica, 1943, v. 1. March.

The article is concerned with those little-described structures, the chondrioma and the centrosome. All of the retinal cells proper possess abundant chondriomas, composed of metochondrias disseminated in the body of the cell, about the nucleus, and along its prolongations. The centrosomes persist as diplosomes in the rods and cones; where they are situated beneath the external segment. There is also a similar diplosome, situated marginally, in the internal granular and the ganglion cells. The crystalloids described by Kolmer are equivalent to those observed by Ramon y Cajal and others.

They represent an involutional alteration of the centrosome. (6 figures.)

Eugene M. Blake.

## 12

### VISUAL TRACTS AND CENTERS

Weskamp, Carlos. Ophthalmic and radiologic diagnosis of tumors of the hypophysis. Anales Argentinos de Oft., 1942, v. 3, July-Aug.-Sept., pp. 111-141.

The author considers briefly the embryology of the hypophysis and the anatomy of the optic pathways, as related to tumors of the hypophysis. The fundus changes are discussed as related to the alterations of the field of vision, and the defects of the latter are illustrated for the various pathologic conditions of the region. Simple atrophy of the optic nerve is characteristic of tumors of the hypophysis.

Emphasis is laid upon the advantage of stereoscopic radiographs and upon the necessity for correct positions of the head in making the pictures. Eye symptoms may be positive when the X ray is negative in cases where the tumor grows out of the sella rapidly. In these cases the injection of air or lipiodol aids greatly in diagnosis. Camperimetric, ophthalmoscopic, and radiographic studies suffice to make an accurate diagnosis in tumors of the hypophysis. The article is beautifully illustrated. (33 figures.)

Eugene M. Blake.

## 13

### EYEBALL AND ORBIT

Garrow, A., and Loewenstein, A. A case of monocular hydrophthalmia, with special reference to its possible relation to the Sturge-Weber syndrome. Brit. Jour. Ophth., 1943, v. 27, Aug., pp. 335-354.

The clinical features of the case reported are these: hydrophthalmia in a patient now aged 11 years, with a cyclodialysis and two trephine operations performed seven years ago, hemorrhage into the substance of the cornea five years ago followed by corneal blood staining, and, finally, complete corneal opacity with deep and superficial vascularity; hypotony for seven years and shrinking for the year preceding enucleation in 1940.

Pathologic examination showed thickening of the corneal epithelium with complete destruction of Bowman's membrane and the presence of blood vessels in all the corneal layers. There was an extreme degree of folding of Descemet's membrane with fan-like distribution at the periphery. The anterior chamber was so densely packed with connective tissue that no space was left. The iris was atrophied and consisted mostly of connective tissue. The ciliary body and the choroid were surrounded by a great effusion of fluid, so much so that the ciliary body was completely separated from the sclera, and the fluid infiltration of the ciliary body had resulted in wide separation of its tissue into bundles. The choroid was swollen and was separated from both the retina and the sclera by effusions.

Three angiomata were found in the eye, one in the posterior part of the choroid, surrounding the head of the optic nerve. This angioma consisted of veins, greatly enlarged but showing normal wall structure. The second angioma was capillary and intraretinal, a short distance from the optic nerve. The third angioma was at the anterior end of the detached retina, originating in the choroid and splitting Bruch's membrane. This angioma was cavernous, consisting of many thin-walled

spaces which showed patchy calcification.

The lens showed a subcapsular organized exudate which was calcified. The retina had assumed a convolulus shape and showed the presence of many cysts, as well as the presence of the angioma described above. The surface of the detached retina was covered by a completely calcified internal limiting membrane. The retinal capillaries were also calcified and there were many calcified ganglion cells.

The presence of the angiomata raises the question whether this is a case of Sturge-Weber syndrome or merely an uncomplicated monocular hydrophthalmia. The features of the fully developed Sturge-Weber syndrome are hydrophthalmia, nevus flammeus of the face, and angioma of the pia mater. Because of the similarity of the choroid and the pia mater, it would appear to be justifiable to suppose that choroidal angioma may often be a part of the syndrome.

Reference is made to the allied anomalies, Recklinghausen's disease, the Treacher Collins or Hippel-Lindau disease, and Bourneville's disease. Description is given of a retinal angioma recently found in a case of Bourneville's disease. (15 figures, references.)

Edna M. Reynolds.

Hare, Robert. Congenital bilateral anophthalmos. *Arch. of Ophth.*, 1943, v. 30, Sept., pp. 320-330.

A discussion of heredity and embryology is followed by two detailed case reports. The authors urge fitting of prostheses even if considerable plastic surgery is necessary to prepare the sockets. The psychologic effect of artificial eyes on a young child is indirect. The reaction of other persons toward him, as they accept or reject him, in-



fluences his emotional and physical progress or retardation. Parents tend to reject or overprotect him; in either situation he is hampered from fully developing his potentialities. Most parents are at a complete loss as to how to aid a child handicapped by such a deformity. The need of placing a child with bilateral anophthalmos under the care of a trained worker cannot be too strongly stressed. (14 figures, references.)

Ralph W. Danielson.

#### 14

##### EYELIDS AND LACRIMAL APPARATUS

Gifford, S. R., Puntenney, I., and Bellows, J. Keratoconjunctivitis sicca. *Arch. of Ophth.*, 1943, v. 30, Aug., pp. 207-216. (See Section 6, Cornea and sclera.)

Sellares, A., and Mendia, J.A. New treatment for acute and chronic dacryocystitis. *Rev. Oto-Neuro-Oft.*, 1941, v. 16, Nov., p. 296.

The writers report marked success in the treatment of acute and chronic dacryocystitis with a 1.25-percent solution of "soluble Prontosil." After local anesthesia and expression of the sac contents, 1 c.c. of the solution is injected into the sac, expressed, and finally the remaining 2 c.c. is slowly injected and allowed to remain. This treatment is carried out three times a week, and as a rule rapidly clears up the suppuration, thus preparing the patient for any necessary surgical measures. In some cases a few washings suffice to restore permeability of the passages. Briefly reported are four cases in which the dacryocystitis had existed from two months to three years. In three of the cases suppuration ceased after three to six washings.

Jerome B. Thomas.

#### 15

##### TUMORS

Constans, G. M. Cholesteatoma of orbit. *Arch. of Ophth.*, 1943, v. 30, Aug., pp. 236-246.

True cholesteatoma of the orbit is a very rare condition arising as a congenital growth from both mesoderm and ectoderm. The criteria of true cholesteatoma are that it possesses no inflammatory wall, is located subperiosteally in the orbit, and contains or is composed of cholesterol crystals. Only five of the previously reported 15 cases qualify as true primary cholesteatomas of the orbit. The author adds an additional case. The patient, a schoolgirl, was first observed when twelve years of age. She complained of a protrusion of the left eye of six months duration. She was examined on several occasions between 1936 and 1941, during which time there was a gradual increase in the proptosis of the orbit, and a mass, attended by some bone erosion, could be demonstrated by X ray. Ocular movements and vision were normal. There was a slight amount of papilledema. An incision was made over the temporal wall of the orbit and the periosteum opened. A subperiosteal dissection was made nearly to the apex, and a large necrotic whitish mass was removed. There was no true wall or capsule. The whitish material consisted of concentrically arranged laminations of a waxy material. Healing was uneventful, with recovery from the proptosis. In this case the tumor was definitely congenital, there being no history of trauma and no indication of an inflammatory mass. John C. Long.

McGregor, I. S., and Hill, J. Reticulin content and prognosis in malignant melanoma of the uvea. *Arch. of Ophth.*,

1943, v. 30, Sept., pp. 291-297.

Inasmuch as papers had been published in which it appeared that the prognosis in malignant melanoma of the uvea was influenced by the reticulin content of the growths, the authors decided to make a study of the 82 patients in this group that had been treated at the Glasgow Eye Infirmary between 1919 and 1939. They were able to get reliable follow-up information on 41 patients. In order that their results may be correlated with those of other workers, the writers go into considerable detail as to their method of silver impregnation in determining the amount of reticulum.

Sex distribution was about equal, and the average survival about eight years. For the most part the group surviving six to 15 years showed a fuller reticulin picture than the group surviving up to six years. Callender and Wilder had found that the spindle-cell types were relatively benign and that a full reticulin content was of good import, while epithelioid and mixed-cell types and a poor reticulin content were of bad import. The present authors are in general agreement with this conclusion, but do not find that the survival time can be gauged accurately from the histologic characteristics of cell type, pigment content, and reticulum content alone. Taken together these characteristics usually permit one to say whether the patient will live a relatively long or short time. Probably the cell type is first in importance, with reticulin content and pigment content as subsidiary factors. The authors were not able to correlate histologic changes with the clinical stage of the tumor, the involvement of the scleral veins, and the extraocular involvement. (Five figures, 2 tables, references.)

Ralph W. Danielson.

## 16

### INJURIES

Appelbaum, Alfred. Simplest instrument for removal of foreign bodies from cornea. *Arch. of Ophth.*, 1943, v. 30, Aug., p. 262.

The author has found the ordinary hypodermic needle superior to any instrument that he has used for the removal of corneal foreign bodies. He recommends the Luer-Lok type stainless-steel 19-gage 2½ inch needle with a long bevel. With this needle, there is no need for a holder as the needle is long enough to be easily manipulated. The needles are autoclaved in small tubes so as to be immediately available.

John C. Long.

Grove, W. E. Eye and ear complications of craniocerebral injuries. *Wisconsin Med. Jour.*, 1943, v. 42, Feb., p. 210.

As eye complications, the author discusses discoloration of lids, pupillary changes, paresis or paralysis of extraocular muscles, loss of accommodation, and changes in visual acuity and in fields of vision.

Theodore M. Shapira.

## 17

### SYSTEMIC DISEASES AND PARASITES

McGavic, J. S. Lymphomatoid diseases involving the eye and its adnexa. *Arch. of Ophth.*, 1943, v. 30, Aug., pp. 179-189.

The lymphomatoid diseases represent a great variety of related clinical and histologic responses by lymphoid tissue to unknown stimuli. Some of the tumors appear to be neoplastic from their onset, while others represent transitions from inflammatory to neoplastic lesions. At times the histologic charac-

teristics will vary considerably with the age of the lesion. Repeated biopsies and frequent differential blood counts must be made throughout the clinical course in order to arrive at a satisfactory conclusion as to the nature of the disease. Long follow-up studies are indicated. At present great difficulties are encountered in diagnosing and classifying the various lymphomatoid diseases.

The author reports 21 histologically proved cases of lymphomatoid disease involving the eye and its adnexa, with an average follow-up period of four years. There are additional notes on 16 cases. The prognosis in lymphomatoid disease is generally poor. Treatment, after confirming the diagnosis by biopsy, consists in active radiation. Excision does not seem indicated unless the lesion is encapsulated, permitting complete removal. In the author's series of 17 primary tumors of the eye and adnexa, 11 of the tumors remained localized and did not result in generalized lymphosarcomatosis. (6 tables, bibliography.)

John C. Long.

Venable, H. P., and Pollock, F. J. *Rickettsias in ophthalmology*. Arch. of Ophth., 1943, v. 30, Sept., pp. 362-370.

Rickettsias are small, gram-negative, bacteria-like organisms, often pleomorphic, generally less than 0.5 micron in diameter, staining lightly with aniline dyes but well with Giemsa's stain, living and multiplying in arthropod tissues and acting as obligate intracellular parasites. Only four forms are known to be pathogenic: 1. *Rickettsia prowazeki* (louse-borne and flea-borne typhus fever); 2. *Rickettsia dermacentroxenus* (tick-borne Rocky Mountain spotted fever); 3. *Rickettsia tsutsugamushi* (mite-borne fever endemic in Japan); 4. *Rickettsia ruminantium* (tick-borne

heartwater in sheep, goats, and cattle).

*Rickettsias* have many features in common with certain bacteria and also with some viruses. Their visibility, morphologic characteristics and nonfiltrability closely ally them with the bacteria. Their staining reaction, growth requirements, and specificity for certain cell types are points of similarity with the viruses. The most logical view is that rickettsias are bacteria which have become adapted to intracellular life in arthropod tissues. They occupy an intermediate position between viruses and bacteria.

As regards trachoma there are two distinct schools of thought. One maintains that the cause is a rickettsia, and the other insists on a virus as the etiologic agent. One school found that there was a definite correlation in geographic distribution between trachoma, lice, and human rickettsial disease.

Of the three known rickettsial diseases in human beings, Rocky Mountain spotted fever affects the eye the least. Most of the patients have only a mild catarrhal conjunctivitis. In tsutsugamushi fever there are hyperemia of the iris, mild conjunctivitis, clouding of the cornea and anterior chamber, iridocyclitis with keratic precipitates, and pannus formation; there is gradual recession of the symptoms with clearing of the infection and residual scar formation in one to two months.

In typhus fever, the following ocular changes are observed: The milder symptoms are hyperemia of the conjunctiva, subconjunctival ecchymosis, ciliary alopecia, miosis, photophobia, hyperemia of the fundus, mydriasis during convalescence, and night blindness. Photophobia is at times so severe that the patient is unable to tolerate ordinary daylight and seeks relief by hiding his head under the pillow. Miosis in-

variably means a poor prognosis.

There is no specific treatment for the rickettsial ophthalmic diseases. General constitutional measures and local symptomatic therapy are indicated. (4 figures, references.)

Ralph W. Danielson.

Woods, A. C. Syphilis of the eye. *Amer. Jour. Syphilis, Gonorrhea, and Venereal Diseases*, 1943, v. 27, March, pp. 133-186.

Woods presents a most thorough and well prepared paper in which syphilis of every structure of the eye is discussed. (28 illustrations, including 4 in color; 74 references.)

Theodore M. Shapira.

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### HYGIENE, SOCIOLOGY, EDUCATION, AND HISTORY

Canadian war-blinded. *Outlook for the Blind*, 1942, v. 36, Dec., p. 281.

Reception, training, and aftercare arrangements for blinded Canadian soldiers are considered. References are made to the last war. On declaration of the present war, arrangements were made for the Canadian National Institute for the Blind to furnish service and for the Canadian government to meet costs of caring for the newly blinded.

Francis M. Crage.

Etchemendigaray, Arturo. Aniridias. *Anales Argentinos de Oft.*, 1942, v. 3, July-Aug.-Sept., pp. 142-154.

The writer discusses at some length the laws of heredity. He then places many ocular diseases under the different classifications (dominants, recessives, and so on). Finally he reports two cases of aniridia, in a 49-year-old father and his 7-year-old son. The latter presented bilateral horizontal nystag-

mus, subluxation of the lenses, incipient cataract, and aniridia. The father showed the same defects, plus secondary glaucoma. (4 figures.)

Eugene M. Blake.

Hayden, A. M. Vision testing in Illinois. *Illinois Med. Jour.*, 1943, v. 83, March, p. 175.

Miss Hayden presents the work of her organization in visual testing of school children in Illinois. A wealth of data has been accumulated.

Theodore M. Shapira.

Kerby, C. E. Eye conditions among pupils in schools for the blind in the United States, 1940-1941. *Outlook for the Blind*, 1942, v. 36, Dec., p. 270.

The article is a report of analyses of data on eye conditions among blind children of school age in the United States. Tables presented show the schools included in the study; etiology, site and type of affection; and other factors of importance.

The findings suggest constant vigilance of health authorities. Knowledge of newer preventive methods is needed. More universal application of methods and procedures already proved effective is urged; for example, immediate hospitalization and sulfanilamide treatment of ophthalmia neonatorum.

Francis M. Crage.

Lancaster, W. B. The story of asthenopia: important part played by Philadelphia. *Arch. of Ophth.*, 1943, v. 30, Aug., pp. 167-178.

This address, the fifth de Schweinitz Lecture, deals with the history of the recognition and treatment of asthenopia. The term originated with MacKenzie one hundred years ago. The publication of Donders' work in 1864 gave a great stimulus to the under-

standing of the condition. A number of Philadelphia physicians, including Dyer, Norris, McClure, Thompson, Weir Mitchell, George Gould, and Edward Jackson added to the knowledge of treatment. Gullstrand pointed out the fallacies in the concept of the formation of images and showed the correct procedure. Unfortunately, Gullstrand's work is hard to follow and has not been widely understood. Repeatedly the author quotes the words of Nicholson, "When a tradition once becomes established by the hallmark of acknowledged authority, it takes more than cold facts to uproot it from men's minds—it takes time." (3 figures, references.)

John C. Long.

Pereira Gomes. *The physical aptitude of aviators.* Brasil-Medico, 1943, v. 57, March 20 and 27. 13 pp.

In Brazil aviation has become an extremely important means of travel. The author quotes United States figures indicating that among aviation disasters 50 percent are due to the pilot and only 5 percent to mechanical defects. The article outlines a complete system of physical examination, including the ocular examination. The refraction should be measured under cycloplegia, to avoid overlooking disturbing amounts of hyperopia and astigmatism. The test for dark adaptation is essen-

tial. Color vision must be perfect. The tests for binocular vision and sense of depth are also referred to.

W. H. Crisp.

Vila Ortiz. *Considerations concerning some medicolegal problems.* Arch. de Oft. de Buenos Aires, 1942, v. 17, Feb., p. 73.

The author emphasizes the importance of determining the visual status existing prior to an ocular injury covered by workmen's compensation laws. The question of post-traumatic trachoma is discussed at length, and the histories of 12 medicolegal cases are reported in detail to illustrate the difficulties involved. Pre-existing trachoma, aggravated by the ocular injury, and post-traumatic trachoma, in which the contagion takes place at the moment of the injury or some time later, presented the main problems in these cases. The author proposes a new medical form in which the physician who first sees the injured must answer a more thorough questionnaire concerning lesions in and around the eyes. Plinio Montalván.

Zarefsky, J. L. *Notes on setting up a register of the blind.* Outlook for the Blind, 1942, v. 36, Dec., p. 277.

The purposes of such a register are noted, and suggestions are offered with special reference to the necessary agencies.

Francis M. Crage.

# NEWS ITEMS

Edited by DR. DONALD J. LYLE  
904 Carew Tower, Cincinnati

News items should reach the Editor by the twelfth of the month

## DEATHS

Dr. Eugene G. Steele, Buffalo, Wyoming, died July 20, 1943, aged 62 years.

Dr. Thomas S. Blakesley, Kansas City, Missouri, died July 14, 1943, aged 65 years.

Dr. Thomas J. Draper, Warrensburg, Missouri, died July 6, 1943, aged 87 years.

Dr. Louis M. Green, Maywood, Illinois, died July 18, 1943, aged 62 years.

Dr. Elias J. Marsh, Paterson, New Jersey, died September 11, 1943, aged 68 years.

## MISCELLANEOUS

Under a new arrangement, whereby the physical plant of the Illinois Eye and Ear Infirmary will be under the supervision of the state department, Dr. Harry S. Gradle has become professor of ophthalmology at the medical school and Dr. Peter C. Kronfeld has become associate professor of ophthalmology and director of education in ophthalmology.

The following papers were presented at a series of meetings held in the Eye Department, Western Infirmary, Glasgow, Scotland, during September: "The fifth nerve and the cornea" by Dr. J. B. Gaylor; "Herpes of the cornea" by Professor Loewenstein; "Experimental corneal ulcers" by Dr. J. M. Robson; and "Chemical injuries of the cornea" by Prof. W. J. B. Riddell.

An influential committee, headed by the vice-chancellor of Oxford, Sir David Ross, Provost of Oriel, is setting about the endowment of ophthalmologic research in the University. The nucleus for such work exists in the Oxford Eye Hospital. The University already has, thanks to one of Lord Nuffield's uncountable benefactions, as Margaret Ogilvie Reader in Ophthalmology, a young woman—Ida Mann—of outstanding attainment and promise in research. The committee hopes to raise a quarter of a million pounds for what seems—surprisingly—to be rather a neglected branch of medical research.

—From The Church Times, London,  
Sept. 10, 1943, page 466.

## SOCIETIES

At a meeting of the Royal Eye Hospital Clinical Society on September 24th, Mr. V. E. Negus, M.S., F.R.C.S., delivered a talk on "The relationship of ophthalmology and rhinology."

Dr. Charles F. Kutscher, Pittsburgh, spoke on "Retinal arteriolar changes in sclerosis and hypertension" at the ninety-third annual session of the Medical Society of the State of Pennsylvania.

Among the guest speakers at the eleventh annual meeting of the Omaha Mid-West Clinical Society was D. Sanford R. Gifford, who discussed "Treatment of some corneal diseases."

At the fifteenth annual meeting of the Aero Medical Association of the United States, Squadron Leader K. Evelyn, R.C.A.F., lectured on "Night vision."

The Oklahoma City Clinical Society held its thirteenth annual conference at Oklahoma City, October 18th to 21st. Among the guest speakers was Dr. Theodore J. Dimitry, who presented a paper on "The modern trend in the treatment of eye diseases."

## PERSONALS

Dr. J. R. Fitzgerald, clinical associate in ophthalmology at Loyola University School of Medicine, was recently appointed supervising ophthalmologist of the Illinois Public Aid Commission.

Dr. Eunice L. Stockwell has been appointed as the professor of ophthalmology at the Woman's Medical College of Pennsylvania.

Dr. Daniel B. Kirby of New York gave the Ophthalmology Lecture at the Centenary Celebration of the Founding of the College of Medicine of Western Reserve University, on October 28, 1943.

